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Influence of Seawalls on Subaerial Beach Volumes with Receding Shorelines

By David R. Basco, Doug A. Bellomo, John M. Hazelton, Bryan N. Jones, Old Dominion University

Prepared for Headquarters, U.S. Army Corps of Engineers

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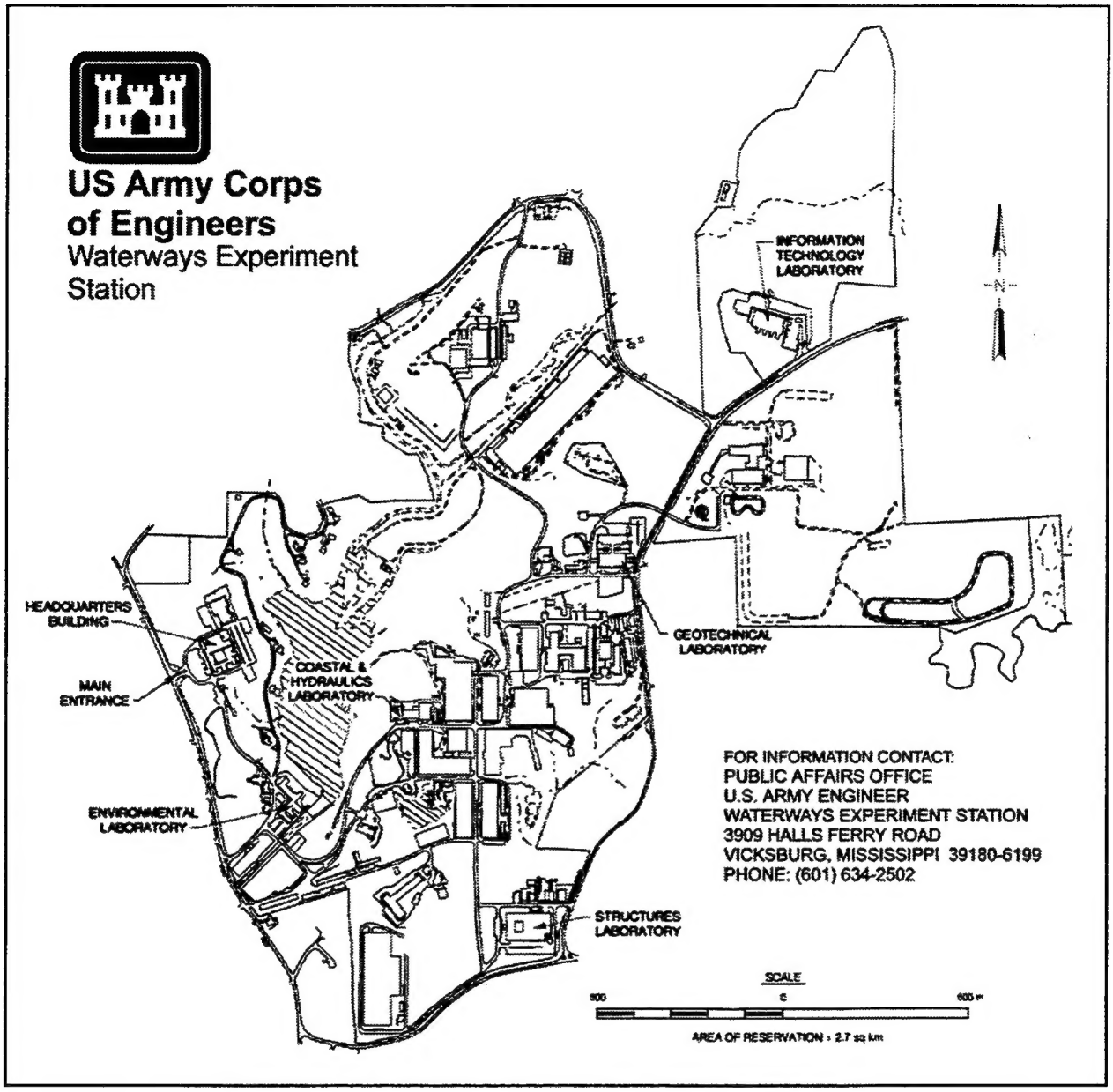

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Preface

The study summarized in this report was authorized by Headquarters, U.S. Army Corps of Engineers (HQUSACE). Research was conducted under Work Units 32535, "Engineering Performance of Coastal Structures," and 32747, "Impacts of Coastal Armoring on Beaches," Ms. Cheryl E. Pollock, Principal Investigator. Funds were provided through the Coastal Structures and Evaluation Branch (CSEB), Engineering Development Division (EDD), Coastal and Hydraulics Laboratory (CHL), U.S. Army Engineer Waterways Experiment Station (WES). The CHL was formed in October 1996 with the merger of the WES Coastal Engineering Research Center and Hydraulics Laboratory. Dr. James R. Houston is the Director of the CHL and Messrs. Richard A. Sager and Charles C. Calhoun, Jr., are Assistant Directors. The HQUSACE Technical Monitors were Messrs. John H. Lockhart; Charles B. Chestnut; and Barry W. Holliday.

Work was performed under the general supervisory direction of Dr. Yen-hsi Chu, Chief, Engineering Applications Unit (EAU), CSEB; Ms. Joan Pope, Chief, CSEB; Mr. Thomas W. Richardson, Chief, EDD; and Ms. Carolyn M. Holmes, Program Manager, CHL.

This report was prepared by Dr. David R. Basco, and Messrs. Doug A. Bellomo, John M. Hazelton, and Bryan N. Jones, Coastal Engineering Centre, Department of Civil Engineering, Old Dominion University, Norfolk, VA.

COL Bruce K. Howard, EN, was Commander of WES during the publication of this report. Dr. Robert W. Whalin was Director of WES.

Conversion Factors, Non-SI to SI Units of Measurement

Non-SI units of measurement used in this report can be converted to SI units as follows:

Multiply	By	To Obtain
feet	0.3048	meters

1 Introduction

The purpose of this investigation was to determine if seawalls are responsible for altering the existing "natural" erosional trend of the shoreline at Sandbridge, VA. Sandbridge is a suburb of the City of Virginia Beach lying south of Cape Henry at the entrance to the Chesapeake Bay, and north of the Virginia - North Carolina border as shown in Figure 1. About 80 percent of the oceanfront is private property with the remainder (25 access paths, public

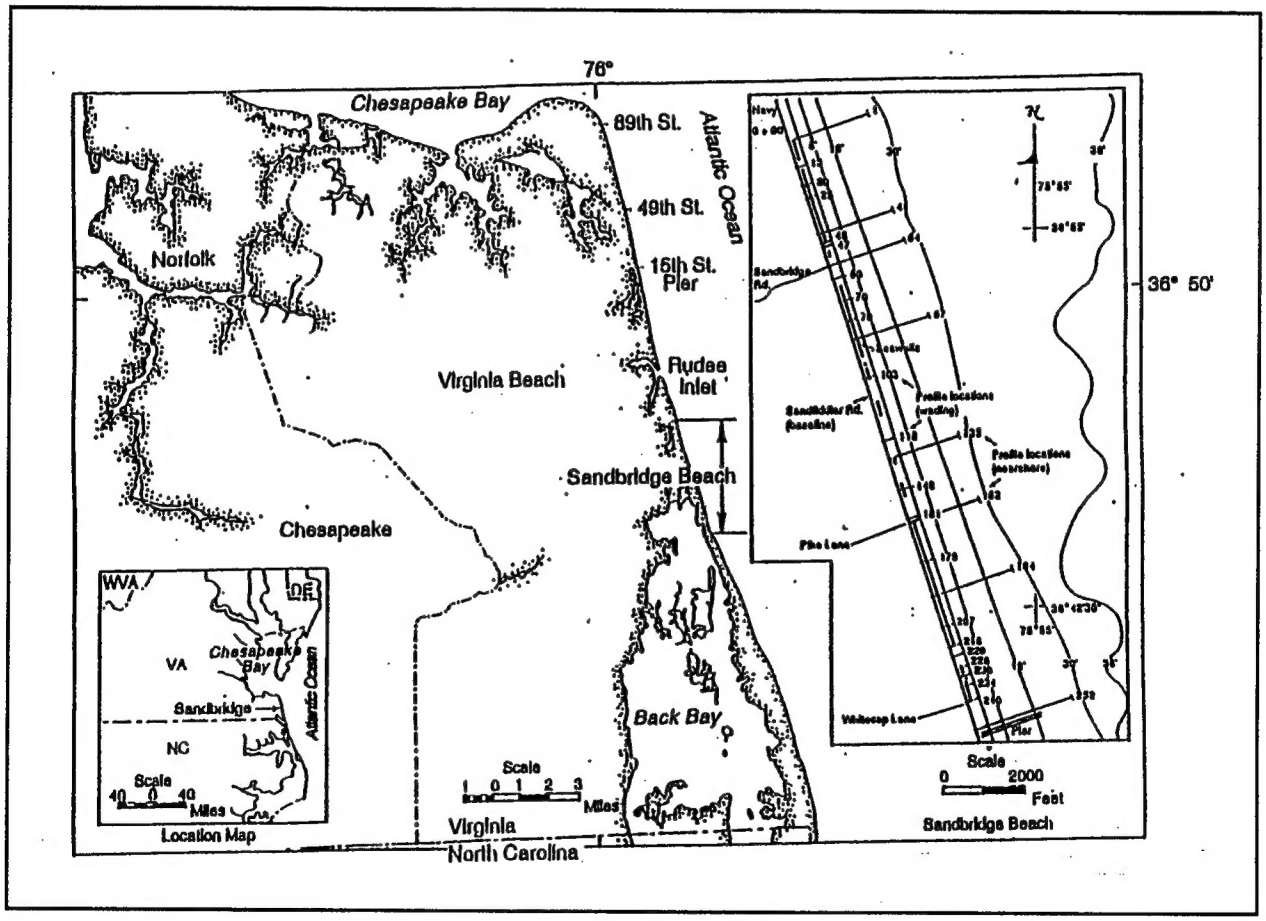

Figure 1. Location map (insert shows seawall locations and numbered profile locations used for this study)

beaches, etc.) belonging to the city. The entire beach is used by local property owners, residents, and tourists as a recreational area.

At one *nonwalled* location near the middle of the study area, Sandfiddler Road was about 45 m from the Atlantic Ocean in 1980; presently less than 25 m of beach remains. The fixed position of the road means that the recreational beach area is shrinking each year. Few argue that the road alone is "...destroying the beach," but this same logic is applied by some when a seawall is present on an eroding shoreline and the dry beach width is reduced each year in front of the seawall (Pilkey and Wright 1988). Eventually, the ocean will reach the road (or walls) and the beach will be gone.

The purpose of this study is *not* to contend this obvious result but to determine from statistically defendable data whether or not the walled sections *increase the existing erosional trend.* In August 1990, the Civil and Environmental Engineering Department at Old Dominion University (ODU) began a program to survey 28 beach profiles at seawall and nonwalled (dune) locations out to mean low water (mlw) (i.e., the subaerial beach). Surveys are conducted once a month and after significant coastal storms. This report summarizes 5 full years of ODU beach profile surveys and 15 years of other available profile data to describe seawall and beach interactions at Sandbridge. Analysis was limited to the subaerial profile above mlw.

The study is sponsored by the U.S. Army Engineer Waterways Experiment Station's Coastal and Hydraulics Laboratory (CHL). CHL is also sponsoring similar long-term field monitoring programs on the Pacific coast (California) and the Great Lakes (Lake Michigan). It is anticipated that results of field investigations at these three different locations will aid in basic understanding of the dynamics between seawalls and beaches.

Chapter 2 briefly summarizes available knowledge and then poses three basic questions to be addressed by the data. The Sandbridge study area is reviewed in Chapter 3. Chapters 4 and 5 give details regarding the data and analysis methods, respectively. The results are presented in detail in Chapter 6 and summarized as answers to the three questions in Chapter 7. Finally, Chapter 8 presents recommendations for mitigation legislation so that the full range of shore protection alternatives (hard, soft, and sand trapping systems) can *coexist* in the coastal zone.

2 Literature Summary

Literature Reviews

The *Journal of Coastal Research* Special Issue No. 4, published in 1988 and entitled "The Effects of Seawalls on the Beach" included a literature review by Kraus (1988) of beach and seawall interactions. Kraus concluded that there were no adverse effects of a seawall on the adjacent beach, if a sediment supply exists. An updated literature review by Kraus[1] is pending publication in this same journal.

Morton (1988) in this same Special Issue, used aerial photos and a few subaerial profiles to investigate wall effects on adjacent beaches at three locations in Texas. At a nonwalled location west of the Galveston Seawall, the shoreline change rate essentially doubled from -0.9m/year (1946-1959) to -2.0 m/year (1959-1980) after the seawall was extended in 1959. However, during this same period, a "control" profile 1 km west at a nonwalled location eroded at -2.7m/year. No data are presented to quantify the relative levels of storm activity during these before- and after-seawall periods. Historic maps (U.S. Coast Survey 1852) reveal a large natural offset at approximately this same position on the island. Sand trapped behind the extended wall is said to be responsible for the increased erosion rate because of the decrease in sediment supply.

Griggs, Tait, and Corona (1994) described the results of 7 years of monitoring at Monterey Bay, CA. They concluded that there were no significant long-term effects of the seawalls on the adjacent beaches and the summer rebuilding of the beach was not influenced by the seawall. They found no difference between winter profiles at walled and nonwalled beaches. At Monterey Bay the shoreline is stable and a steady sediment supply exists. These conditions are different at Sandbridge where a long-term, erosional trend exists.

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[1] Personal Communication, 1994, Dr. Nicholas C. Kraus, Senior Scientist, Coastal and Hydraulics Laboratory, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Definitions and Terminology

Long before roads, houses, and seawalls were constructed at Sandbridge, the natural shoreline was receding on average about 2 m/year (see Chapter 3). This is defined as the *natural*, background shoreline recession rate $\dot{P}_N$. If $\dot{P}_A$ is defined as the recession rate *after* man's activities, then a coastal "recession" ratio R_P is defined as

$$R_P = \frac{\dot{P}_A}{\dot{P}_N} \tag{1}$$

and the subscript P means that shoreline *position* relative to a fixed baseline is used to calculate the ratio R.

Where profile data are available to calculate *volumes*, the actual coastal erosion ratio R_V should be employed, i.e.,

$$R_V = \frac{\dot{V}_A}{\dot{V}_N} \tag{2}$$

where $\dot{V}_N$ is the natural erosion (volume loss) rate and $\dot{V}_A$ is the erosion rate after construction of roads, seawalls, etc. at a particular location. Clearly, if R_V (or R_P) is proven to be greater than unity under similar climatological conditions, then it may be concluded that man's activities have increased the natural, historical erosion at that site. The "level" of impact on adjacent beaches (1 percent, 5 percent, 10 percent, 50 percent, etc.) needs quantification and may be time-dependent, $R_V(t)$.

Pilkey and Wright (1988) use the terms "passive" and "active" erosion of the beach to distinguish between natural and man-made structural causes, respectively. However, Pilkey believes that arguments surrounding this distinction are irrelevant (Pilkey 1988).[1]

> "The real question and controversy is whether 'active' beach degradation occurs. But this argument, an interesting one to us, is of no consequence to the public."[1]

and,

[1] Personal Communication, 1990, O. H. Pilkey, Department of Geology, Duke University, Durham, NC.

> "The question of concern to the public is whether beaches are degraded in front of seawalls. Whether . . . (natural) . . . conditions are involved or not is beside the point and of no interest to them."[1]

The authors believe the public *is* interested in the distinction and the relative magnitude of R_V as discussed further in Chapter 8.

Three Basic Questions (Hypotheses)

The authors have distilled the concerns expressed in the literature about seawalls on adjacent beaches into three basic questions that can be addressed by the subaerial profile data:

QUESTION NO. 1
Does the sand volume seaward of walls erode faster than the volume seaward of the "partition" for nonwalled locations?

At nonwalled locations, the profile volume was divided by an imaginary line (partition) extending from adjacent walls. For question No. 1, only volumes seaward V_S of the walls or "partition" at nonwalled locations were considered.

QUESTION NO. 2
Do seawalls delay beach recovery?

Starting volumes were defined seaward for October 1, 1990 (ODU data set) and the volume difference ΔV_S was studied to obtain seasonal variations (winter versus summer) and the time when the seaward volume recovered.

QUESTION NO. 3
Is the sand volume landward of the "partition" at nonwalled locations eroding at a faster rate after construction of adjacent seawalls?

For question No. 3, only the volume landward difference ΔV_L at nonwalled locations was considered and the entire 15 years of data was divided into time intervals before and after nearby walls were constructed.

The upland sand volume trapped beneath the road and behind walls is removed from the complete littoral system (dune, subaerial, and subaqueous beach). Less sand is available than the natural, background sediment volume which was historically in negative imbalance. On a naturally eroding coastline, as (a) the length of the walls increases, and (b) the natural, dry beach width decreases, theoretically, the *historic, negative* sediment volume imbalance should also *increase* due to the retention of sand volume beneath roads or

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1 Personal Communication, 1990, O. H. Pilkey, Department of Geology, Duke University, Durham, NC.

behind walls. Dean (1986) also believes the sand retained behind seawalls is responsible for any "end-of-wall" effect on adjacent, nonwalled beaches.

The principle of sand conservation or a sand budget must always be remembered when analyzing the effects of coastal armoring on adjacent beaches. If seawalls accelerate erosion, then the additional eroded sand volume must appear somewhere else.

Evidence from the data will be judged as supporting, nonsupporting, or inconclusive regarding the above three questions as applied to the Sandbridge subaerial profile data set.

3 The Sandbridge Study Area

Geologic and Topographic Setting

Sandbridge Beach is located about 25 km south of the entrance to the Chesapeake Bay (Figure 1), which was formed by the drowning of the Susquehanna River Valley as sea level rose at the end of the Pleistocene. Multiple episodes of global sea level change driven by glacial and post-glacial variability, fluvial processes during the last major lowstand of sea level, and modern tidal flow and sediment transport regimes through and around the bay mouth are all responsible for the complex nearshore bathymetry at this location (U.S. Army Corps of Engineers 1985). Sandbridge, VA, is quite literally a 'sand bridge' about 7.7 km long and only about 250 m wide at its narrowest point. It lies at the northern end of a 120-km-long barrier strip which terminates at Oregon Inlet, NC. This barrier beach system protects the Albemarle Sound and Currituck Sound in North Carolina, and Back Bay in Virginia.

The central section of Sandbridge is the terminus of an elevated topographic feature (ridge) that serves as the drainage divide upland of the coast. The north and south elevations are about 0.6 m lower than the middle, which has led to the further division of the study area into three sublengths as discussed in Chapter 4.

The average, median grain size of the sandy beach is about 0.25 mm (Bellomo 1993, Wright et al. 1987). A clay layer exists about 3 m below the mean sea level as determined by borings (Bellomo 1993). However, clay outcroppings have been observed at higher levels during recent, severe winter seasons and after storm events at various locations.

Historic Shoreline Change Rates and Coastal Processes

The historic shoreline recession rates at Sandbridge (as calculated from shorelines located on maps dating to 1858) show a linear variation from -1.1 m/year on the north end to -2.9 m/year at the southern end of the 7.7-km study area (Everts et al. 1983). Aerial photographic data over the past 47 years (Dolan 1985) confirm these trends as shown in Figure 2a. Deeper water close to shore at Sandbridge (Figure 2b) focuses wave energy (Figure 2c) that produces the net sediment imbalance at this location. The southern end is a nodal point for net sediment transport in both north-south and offshore directions. The north-directed, net sediment transport rate from eroding beaches at Sandbridge and Dam Neck is about 150,000 m^3/year (U.S. Army Corps of Engineers 1985, The Traverse Group 1980, and others).

Relative Severity of Coastal Storms Since 1980

Mean tidal range at Sandbridge is 1.04 m. Elevated water levels (storm surge) associated with coastal storms have been evaluated (U.S. Army Corps of Engineers 1992) from measured tidal data and predict a 2.65-m (National Geodetic Vertical Datum (NGVD)) event with a 1-percent change occurrence in any one year.

The historic shoreline retreat at Sandbridge is the result of time averaging of storm events and beach rebuilding processes that together over long time periods have produced the sediment volume imbalance. To characterize the relative magnitude of the storm season, we have first defined the wave year between October 1 and September 30 of the following year so that all 6 months of the same winter season are combined (October - March, incl.). Wave data have been obtained from the Corps' Coastal Engineering Field Research Facility (FRF) at Duck, NC, which is about 60 km south of the study area and possesses a similar wave climate. As an indicator of the relative severity of each wave year since 1981, the total number of hours each year that gauge No. 625 (end of pier, 8-m water depth) has recorded wave heights equal to or greater than 2.0 m has been used. These results are shown in Table 1 as a scale to rank the wave years since 1980. For the 8-year period, 1981 - 1988, the mixture of winter season wave climates (low, medium, high) was about the same as the following 6-year period, 1989 - 1995. Neither period can be classified as excessively stormy (or mild) relative to the other.

Wright et al. (1987) used the calendar year wave data from the FRF at Duck, NC, for 1982 to define 55 wave combinations (height, period, direction) and their duration. A numerical model was then used to find the breaking wave height distribution along the coast. The time weighted-average results for H_b are reproduced here in Figure 2c. Clearly, the spatial gradients in broken wave height are responsible for the sediment imbalance at Sandbridge.

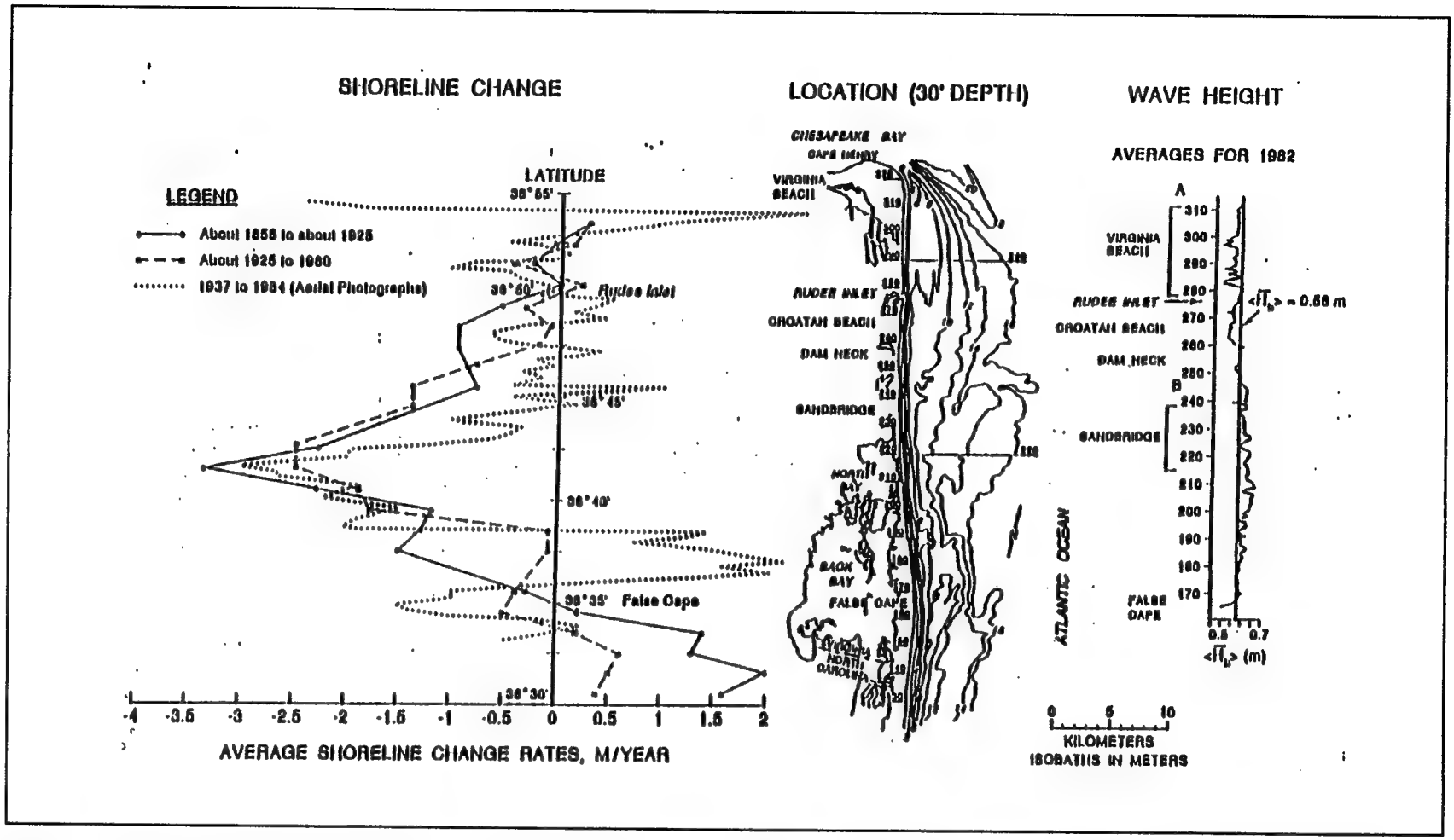


Figure 2. Recession rates, bathymetry, and averaged breaking wave height; (a) Recession rates in meters per year from map data (Everts et al. 1983) and aerial photographs (Dolan 1985, dotted line), (b) Bathymetry from Cape Henry to Virginia/North Carolina border, (c) Averaged breaking wave height from a computer simulation of 55 wave conditions during 1982 (from Wright et al. (1987))

Table 1
Wave Year Severity Scale

Number	Category	Average Duration, hr	Range, hr
1	Low	210	< 260
2	Mild	310	260 - 355
3	Average	400	355 - 445
4	Stormy	490	445 - 575
5	High	650	> 575

The magnitude, however, was too small to account for the measured shoreline recession and estimated longshore sediment transport. Wright et al. (1987) therefore concluded that a large offshore transport must exist. In retrospect, calendar year 1982 was relatively mild in wave energy and the use of calendar year wave data does not properly account for the entire winter season storm events in sequential order. The quantity of offshore sediment flux is probably far less than that estimated by Wright et al. (1987).

Seawall Construction History

Sandfiddler Road at Sandbridge was first constructed in the early 1950's. One homeowner erected a concrete wall in the 1960's but it was not until 1978 that a timber, sheet-pile wall appeared to protect five lots (137 m) at location 148 in Figure 1 (insert). By the end of 1987, about 700 m of seawalls existed. Between 1988 and 1990, 3,917 m of seawalls were built. There are presently 4,738 m of seawalls at 16 different sections that account for 62 percent of the oceanfront shoreline at Sandbridge. Figure 3 graphically displays the rapid rise in seawall construction between 1988-1990. As discussed above, the 7 years before this interval (1981-1988) and the 6 years following (1989-1995) both had similar wave histories and storm climates. Therefore, the assumption is made that similar storm climates prevailed in the periods before and after major seawall construction at Sandbridge.

Seawalls at Sandbridge are built to protect septic tanks, driveway concrete slabs, and other property at ground level. They are all built on private property using private funds and average costs are about $40,000 per 25- to 30-m lot. Since 1978, 26 percent (1,250 m) of the walls have received some storm damage, with some walls damaged more than once at the south end. In all the years of wall storm damage, Hurricane Gordon in November 1994 was the first storm severe enough to expose the septic tanks of five houses behind damaged walls. The city of Virginia Beach condemns and closes houses without septic tank facilities for sanitation. The seawalls were constructed to mitigate the damage to property behind the walls, not to protect the beach. At Sandbridge, the private property boundary on the ocean is at the mlw elevation. Property owners have deeded ownership of the beach to the mlw elevation.

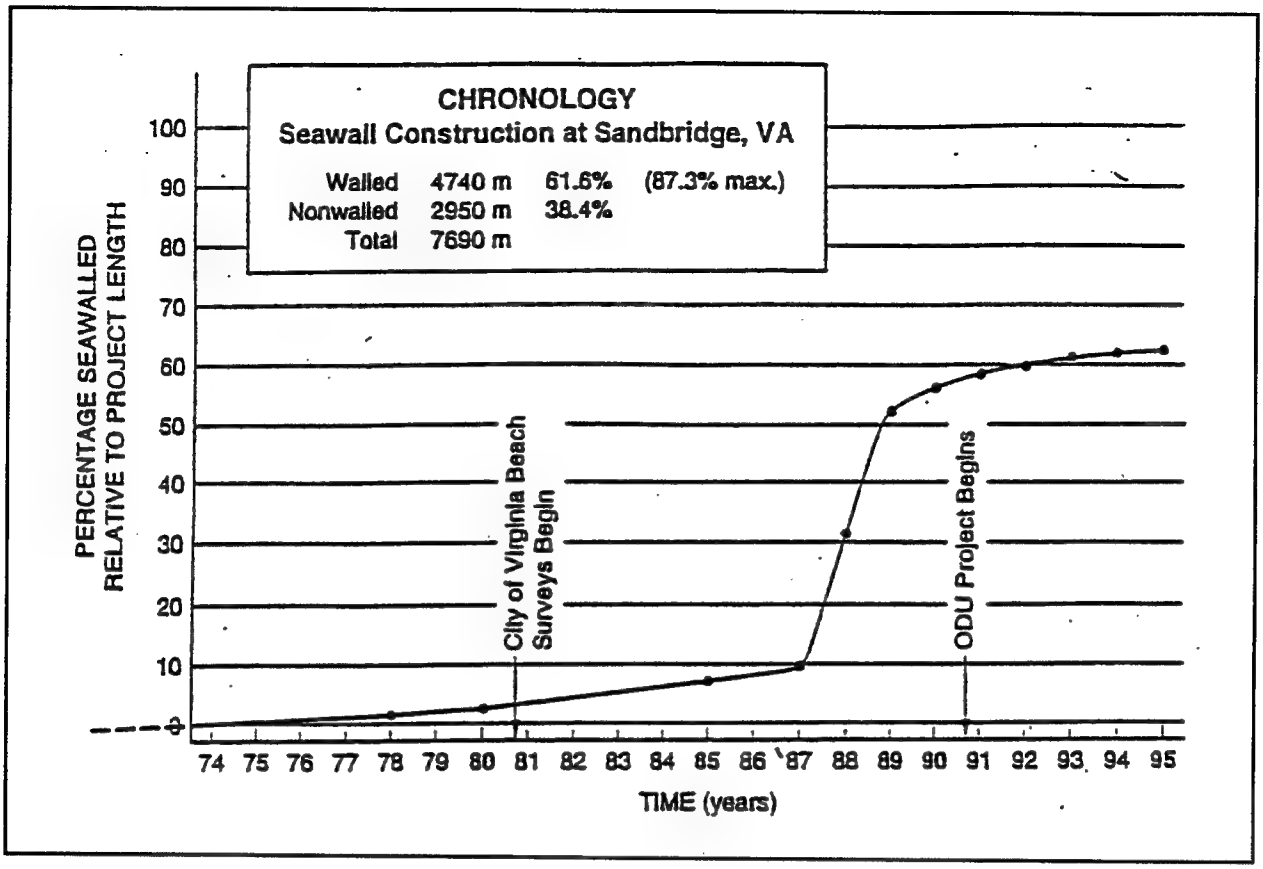


Figure 3. Chronology of seawall construction at Sandbridge, VA

Relative Sand Volume Trapped

The total volume of subaerial beach sand was about 1.3 million m^3 in October 1980. This is the volume beneath the surface profile bounded by the baseline (Sandfiddler Road), the mlw intercept and over the entire 7.7-km project length. Profile data collected for this project and by others (see Chapter 4) have been used to calculate the volume change with time as shown in Figure 4. At this writing (fall, 1995) the total volume is about 73 percent of the October 1980 level. Wall construction during this same period has retained an ever-increasing percentage of the dwindling total sand volume behind the walls as shown in Figure 5 such that only 50 percent remains in front of walls and at nonwalled locations.

The volume trapped beneath the road (baseline) is estimated as 150,000 m^3, or 11.5 percent of that originally present in October 1980.

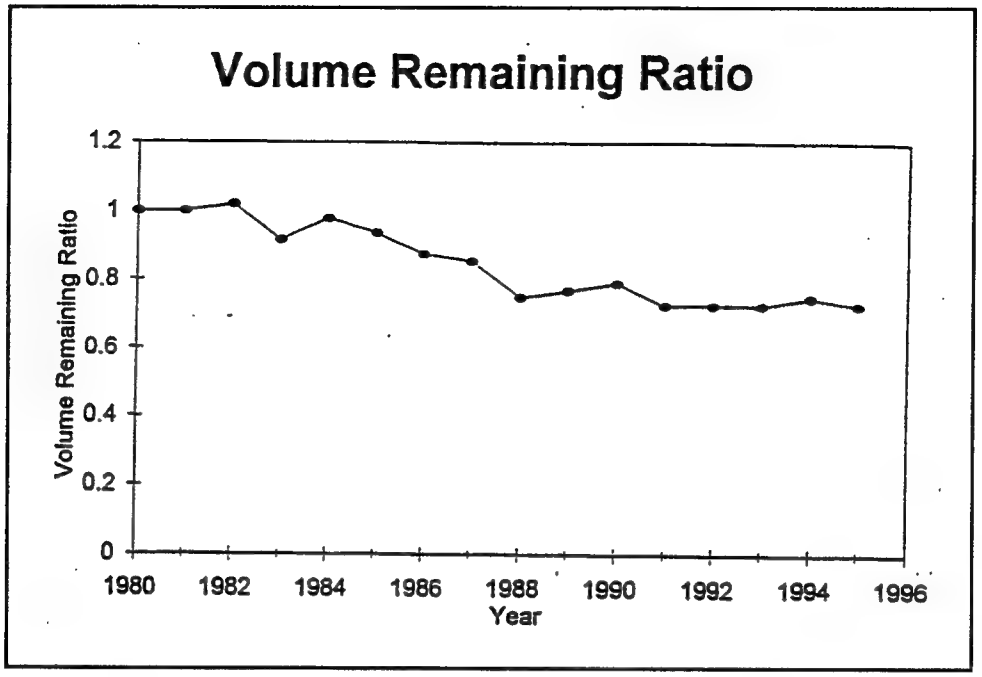


Figure 4. Subaerial volume remaining relative to August 1980 at Sandbridge, VA

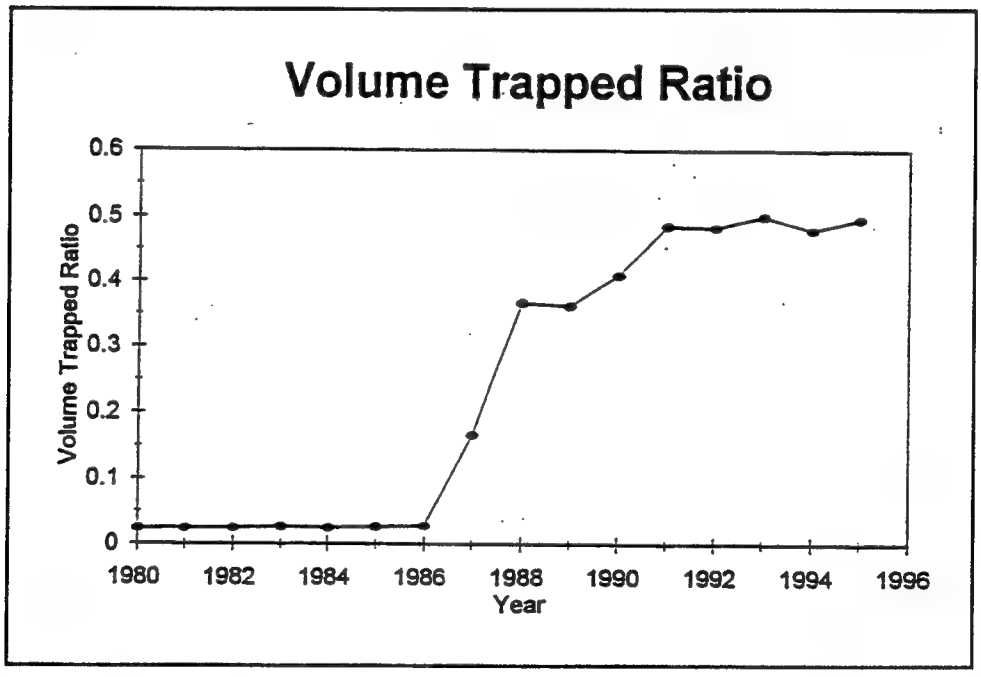


Figure 5. Sand volume trapped behind walls relative to total volume remaining each year at Sandbridge

4 Datums and Data Sets

The city of Virginia Beach vertical datum (0.0) is mean sea level, 1929. Mean low water (mlw) is -0.37 m (below) and mean high water (mhw) is +0.67 m (above) this datum. Figure 6 shows the horizontal baseline which follows the middle of Sandfiddler Road to profile 162 and is then extended (dotted line) to the southern boundary at profile 252. Each profile is numbered by the distance in hundreds of feet south of the Dam Neck Navy property

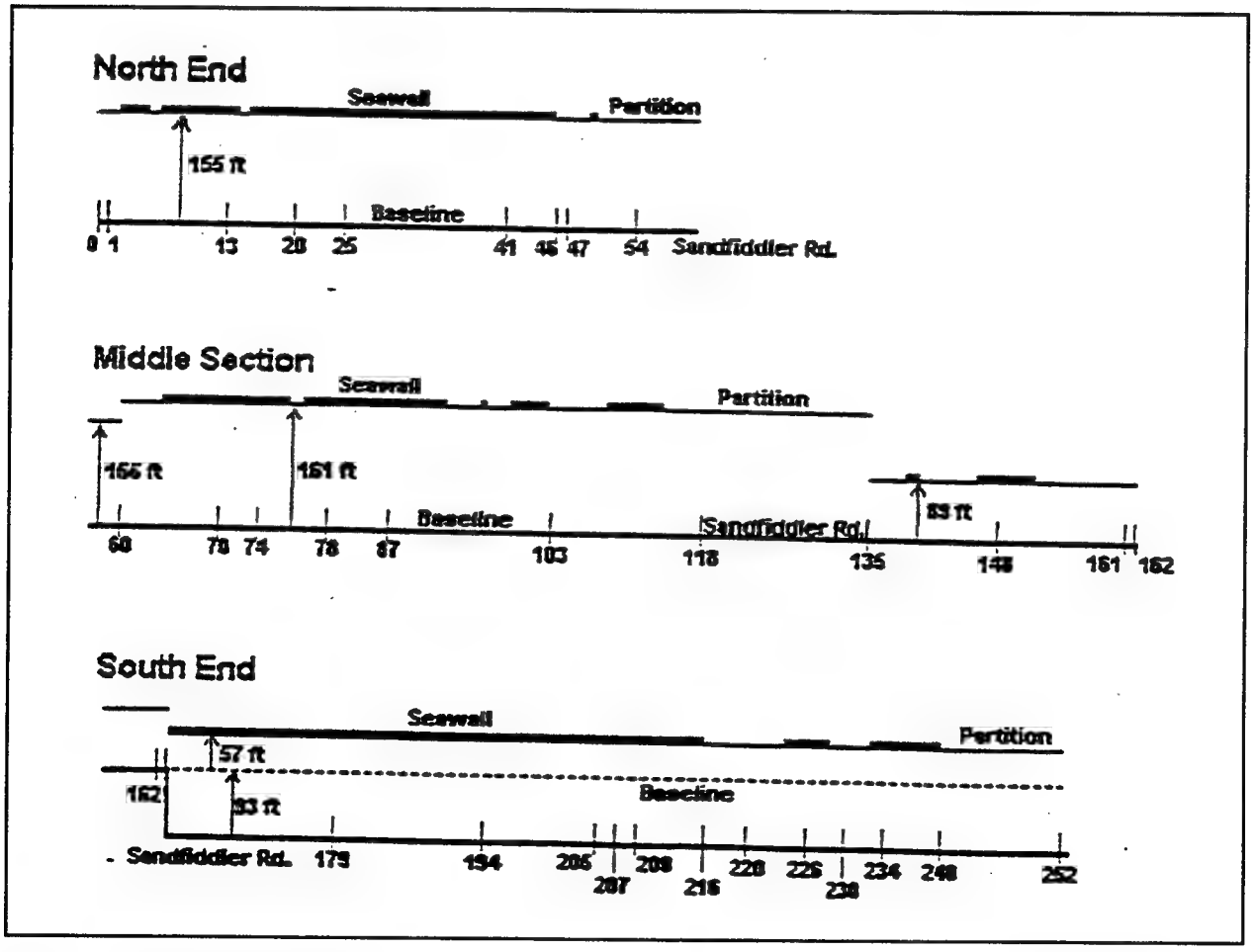


Figure 6. Locations of beach profiles (numbered), baseline (Sandfiddler Road and extension), seawalls (dark line), and partition (thin line) for nonwalled locations

boundary on the north end. Figures 1 and 6 show the location of the 28 profiles surveyed monthly since August 1990. Each profile extends about 120 m seaward of the baseline to elevations below mlw. Presently, 13 ODU profiles are across walls, 11 are at nonwalled locations, and 4 are located at the ends of walls. At two locations (Profiles 13 and 25), seawall construction has occurred during this project.

Beach profile data have also been obtained from the regular survey program of the city of Virginia Beach since October 1980 and from a 1-year program by the Virginia Institute of Marine Science 1988-1989 (Hardaway and Thomas 1990). Some of the profile locations from the three survey data sources coincide. All the survey data have been archived in CHL's Interactive Survey Reduction Program (Birkemeier 1984). As of December 1995, there are more than 2,700 profile surveys in the data set for 53 locations over 15 full wave years (October 1980 - September 1995). For this study, 34 profile locations were employed because the other 19 locations were not surveyed regularly or for less than 1 year.

Four profile locations have had seawalls constructed over the 15-year period and seven nonwall profiles were surveyed before the boom in seawall construction in 1989.

5 Data Analysis Methods

Profile Parameter Definitions

Figure 7 shows all the profiles taken at profile 25, with some before and some after wall construction. A similar "envelope" plot for profile 252 at the southern end is presented as Figure 8. To quantify profile change in space and time, five profile parameters are defined in Figure 9. The total volume (per unit shoreline length) beneath each profile and bounded by the baseline and mlw intercept is V_T. For seawalled locations, this is divided into the volume seaward of the wall V_S and the volume landward (behind) the wall V_L. Clearly, V_T is the sum of V_S and V_L.

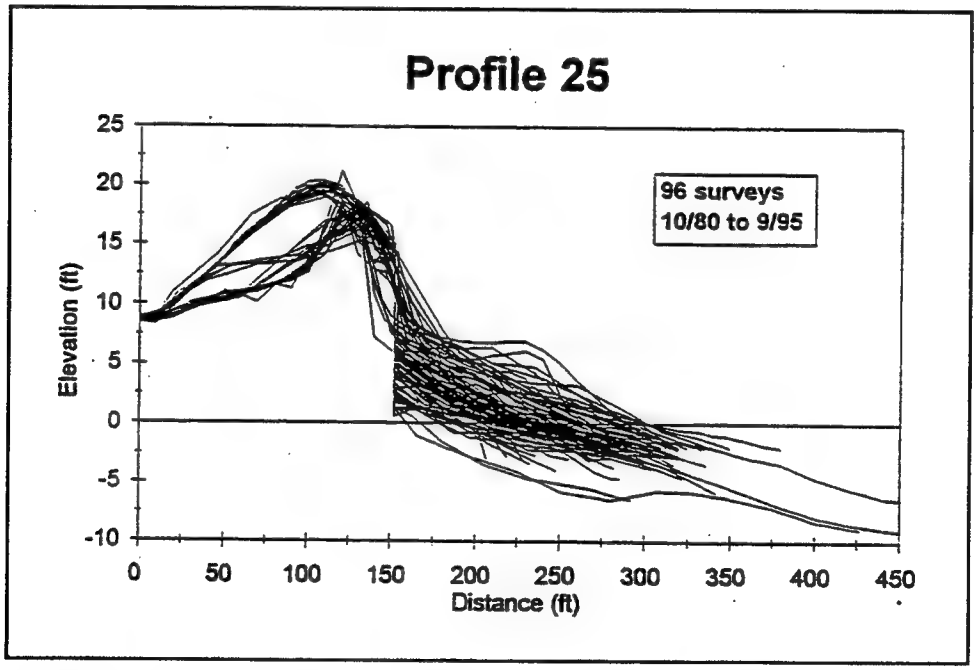


Figure 7. Subaerial beach profiles at profile location No. 25 taken between October 1980 and September 1995. The wall was constructed in 1989 about 45 m from the baseline. This envelope contains 96 surveys

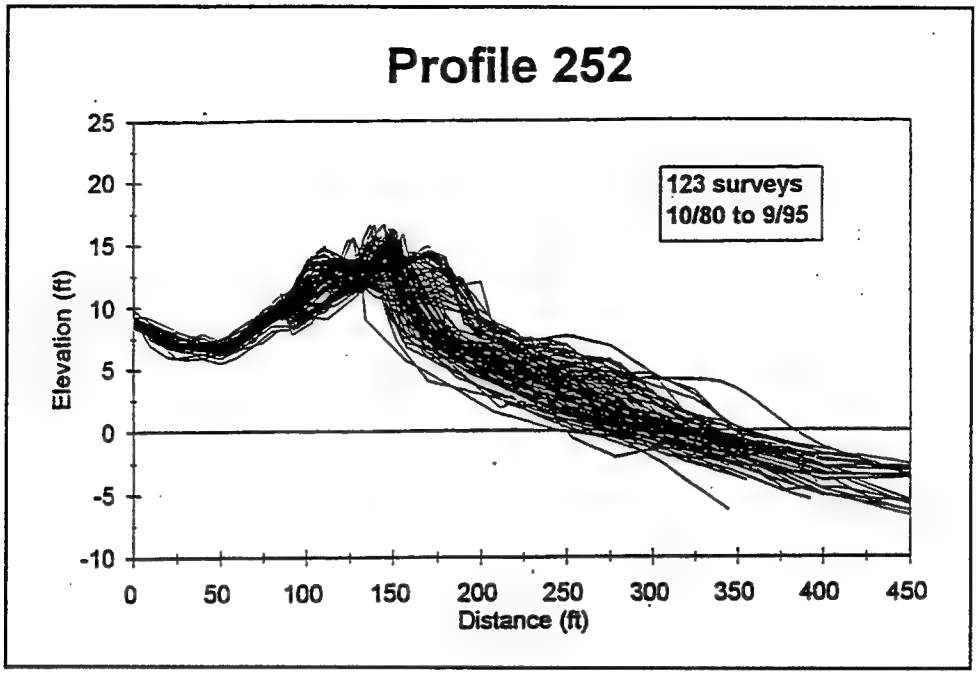


Figure 8. Envelope plot at profile location No. 252 on the extreme southern end containing 123 surveys from October 1980 to September 1995[1]

Where no walls exist, an imaginary "partition" (see Figure 6) is defined by extending the adjacent walls parallel to the shoreline. Hence, for all nonwalled locations, V_S is the volume seaward and V_L is the volume landward of the partition, respectively.

Shoreline position P is defined as the horizontal distance from the baseline to where the profile intersects the mhw elevation. The berm elevation E_B is defined as the vertical distance from the 0.0 datum to the profile elevation at the seawall or imaginary partition.

Volume change is the true measure of shoreline erosion at road or wall locations on eroding shorelines where the shoreline position P becomes fixed.

Profile Analysis Methods

Three basic methods have been developed to analyze changes in the profile parameters: (a) the weighted average method (WAM), (b) the sectional weighted average method, (WAMSECT); and (c) the individual profile method (IPM). Linear regression was used to find the time rate of parameter change for each method.

[1] A table of factors for converting non-SI units of measurement to SI (metric) units is presented on page vii.

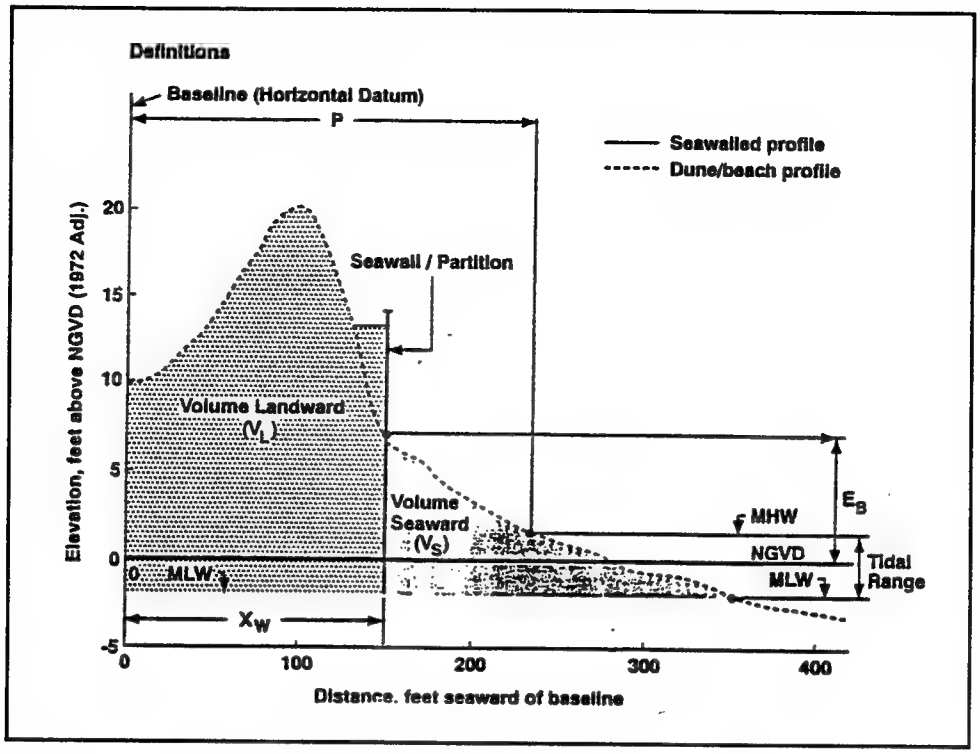


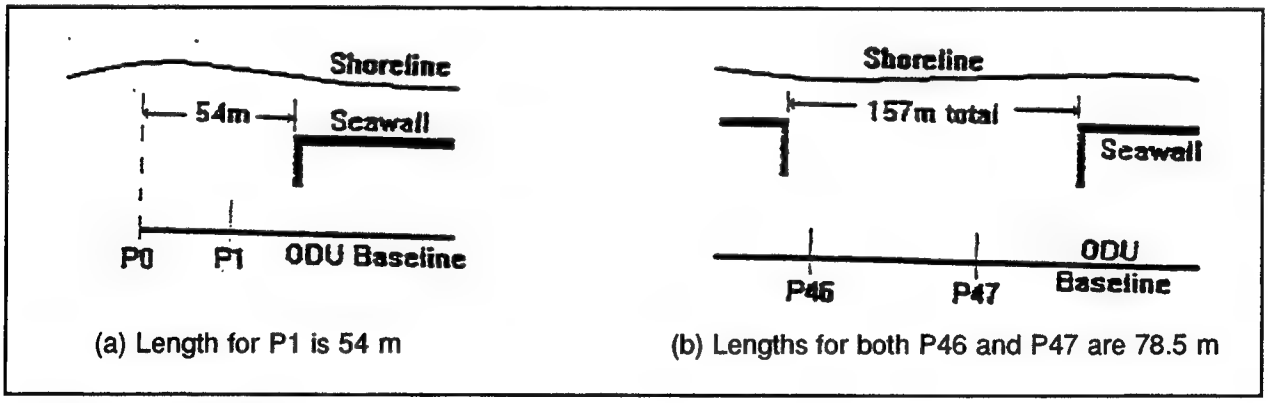
Figure 9. Definitions of beach profile parameters (V_S, V_L, E_B, P)

Weighted average method (WAM)

This method used only the 28 ODU profile locations surveyed since August 1990, which were separated into two groups, walled and nonwalled. Each profile was assigned a representative length of beach (as shown in Table 2), and represents the walled or nonwalled conditions along this particular length of shore. If a single profile occupies a section of walled or nonwalled beach, that profile is assigned the entire length for that section. For example, Figure 10a shows the 54-m-long nonwalled section of shoreline containing profile 1. Since profile 1 is the only profile taken along this stretch of beach, it is assigned the entire 54 m as its representative length. If more than one profile is taken along a stretch of walled or nonwalled shoreline, the representative lengths for those profiles are determined by an average of the profiles occupying that total length of shoreline. Figure 10b shows the 157 m of nonwalled beach containing profiles 46 and 47. The resulting representative length for each profile is the total length of the section divided by the number of profiles sharing that section, or 78.5 m. If no profile occupies a section of walled or nonwalled beach, that length is added to the nearest profile of the same type. For complete details on the assignment of section lengths to profiles for the WAM, see Bellomo (1993).

Table 2
Weighted Average Representative Lengths for ODU Profiles

Dune Profile Number	Representative Length, m	Wall Profile Number	Representative Length, m
1	54	13	172
46	78.5	20	546
47	78.5	25	187
54	142	41	405
60	331	70	413
103	311	78	308
118	364	87	491
135	489	148	207
161	187	179	545
162	187	194	545
216	114	207	545
220	114	226	149
230	124	234	226
240	189		
252	189		
Total Lengths	2,953		4,738



(a) Length for P1 is 54 m

(b) Lengths for both P46 and P47 are 78.5 m

Figure 10. Assignment of representative lengths to profile sections

The wall profile parameter is multiplied by the representative length and all products are summed and then divided by the total wall length of 4,738 m. The result is a single set of five weighted averaged parameters (V_S, V_L, V_T, P and E_B) for each survey that represent all the wall profiles at Sandbridge. The same scheme was used for all the nonwalled profiles, but with different representative lengths totaling 2,953 m of nonwalled beach. The WAM is useful to characterize generalized beach change for the entire 7.7-km project length.

Sectional weighted average method (WAMSECT)

Figure 6 shows three subreaches (north, middle, south) that attempt to recognize differences in barrier island elevation and erosion rates as discussed in Chapter 3. Profiles 1 - 54 (eight-total) were placed in the northern section, profiles 60 - 162 (ten-total) into the middle section, and profiles 179 - 252 (ten-total) into the southern section. As with the WAM, weighted averages were employed for each category (walled or nonwalled) in each section based on the lengths of walled and nonwalled beach in each section. Representative lengths employed for each profile are shown in Table 3. Again, only the ODU data were employed because earlier surveys did not always have a representative number of profiles in each section and in each category.

Individual profile method (IPM)

The five profile parameters were calculated for all surveys dating back to October 1980 for each particular profile. This method permitted the profile history to be analyzed beyond the 5 years of ODU monitoring. Parameter rates of change could be looked at before and after wall construction, but only for each individual profile location.

The three analysis methods described above are analogous to studying (a) a forest; (b) three subareas of the forest, and (c) individual trees in the forest relative to two types of trees and five parameters that characterize the health of each tree.

Time Scales

Three basic time scales are used in the analysis: (a) regression rates before and after wall construction over 6 - 8 years; (b) seasonal variations over winter (October - March) and summer (April - September) seasons; and (c) post-storm and subsequent storm recovery trends.

Seasonal variations of profile parameters were studied using WAM results and mathematically modeled as a sinusoidal wave with a wave length of 1 year. The equation employed was:

Table 3
WAMSECT Representative Lengths for ODU Profiles

North End			
Dune Profile Number	**Representative Length, m**	**Wall Profile Number**	**Representative Length, m**
1	54	13	344
46	78.5	20	312
47	78.5	25	312
54	213	41	335
Total Lengths	424		1,303
Middle Section			
Dune Profile Number	**Representative Length, m**	**Wall Profile Number**	**Representative Length, m**
60	260	70	413
103	311	78	308
118	364	87	491
135	489	148	213
161	187		
162	187		
Total Lengths	1,798		1,425
South End			
Dune Profile Number	**Representative Length, m**	**Wall Profile Number**	**Representative Length, m**
216	114	179	545
220	114	194	545
230	124	207	545
240	189	226	149
252	189	234	226
Total Lengths	730		2,010

$$Y = b + m(t) + a\sin(-2\pi(t - t_0)/365) \quad (3)$$

where

Y = parameter value (V_S, V_L, V_T, P or E_B)

b = parameter initial value, constant, October 1990 from regression

m = slope of best fit, linear regression line

a = amplitude of model, sine wave

t = time in number of days

t_O = start date, October 1990

After finding b and m by linear regression, the amplitude was found by using the value a that produced the minimum total variance between measured WAM values and the predicted sine wave values Y. Again, only the 5-year ODU data were employed. All values in the seasonal variation analysis were actually the difference between WAM values and the starting value b or linear regression intercept on October 1, 1990. Seasonal changes between winter and summer beach profiles are clearly seen by changes in the parameter "differences."

Statistical Analysis

The null hypothesis test was used to determine if one parameter's slope was statistically greater than the other for the WAM and WAMSECT results. The null hypothesis test was performed by calculating the Z-test statistic;

$$Z = (X_1 - X_2)/\sqrt{(\nu_1/N_1 + \nu_2/N_2)} \quad (4)$$

where

X = parameter regression slope

N = number of observations used in the regression

v = variance of the measured data about the calculated seasonal sine wave

The two slopes being compared are statistically equal if the Z value is between 1.96 and -1.96. If the Z value is outside of this range, the null hypothesis must be rejected, and the slopes must be considered statistically different. This can be said with a 95-percent level of confidence from both sides of the mean, or a two-tailed test (Bethea and Rhinehart 1991).

6 Results

Time Scale Trends

Volume seaward difference

Trends in the three time scales (5 years, seasonal, and storms) are best demonstrated by plotting WAM results for the volume seaward *difference* ΔV_S for 5 full wave years of ODU profile data. The initial value V_{So} is taken as the regression line intercept for October 1, 1990 or the starting point for wave year number one. The difference ΔV_S reflects the relative volume change with time over 5 years between winter and summer seasons and following storm events.

Figures 11 and 12 present the results for the dune and wall sections, respectively. In general, sand is dragged off the subaerial beach by winter season storms (October - March) to be deposited as nearshore bars and returns the next summer season (April - September) as rebuilt beach berms. The imbalance in the "dynamic equilibrium" is reflected in the negative slopes of the linear regression lines which were -1.80 m^3/m for the dunes and -1.58 m^3/m for the walled sections. This difference in regression line slopes is *not* statistically significant as discussed further below.

It is apparent from Figures 11 and 12 that the winters of 1992 - 1993 and 1994 - 1995 were the most severe in magnitude. The seaward volume was below the mean (decreasing) value. The 1990 - 1991 and 1993 - 1994 winters were mild in comparison. It is also apparent that some summer periods had better beach "rebuilding" waves than other summers. With the exception of the 1994 - 1995 wave year, the walled sections recovered to about +7 m^3/m (ΔV_s) during the summer, which was the summer value prior to October 1, 1990. The dune sections, however, continue to fall far below the sand volume present during the 1990 summer season.

To model the seasonal variations, a simple sinusoidal function given by Equation 3 is used. The amplitude a that produced the least variance between measured WA values and predicted sine wave values Y was estimated and is shown as the dotted curve on Figures 11 and 12. The amplitudes a were

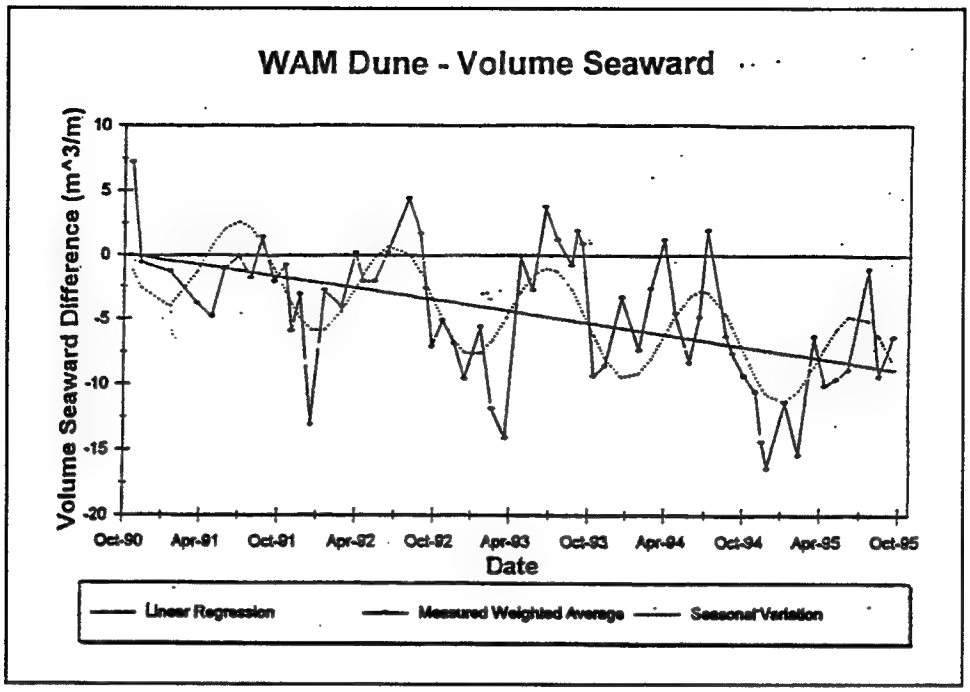


Figure 11. Volume seaward difference versus time for nonwalled sections using weighted average method (WAM) for 5 full wave years (Oct 1990 - Sep 1995)

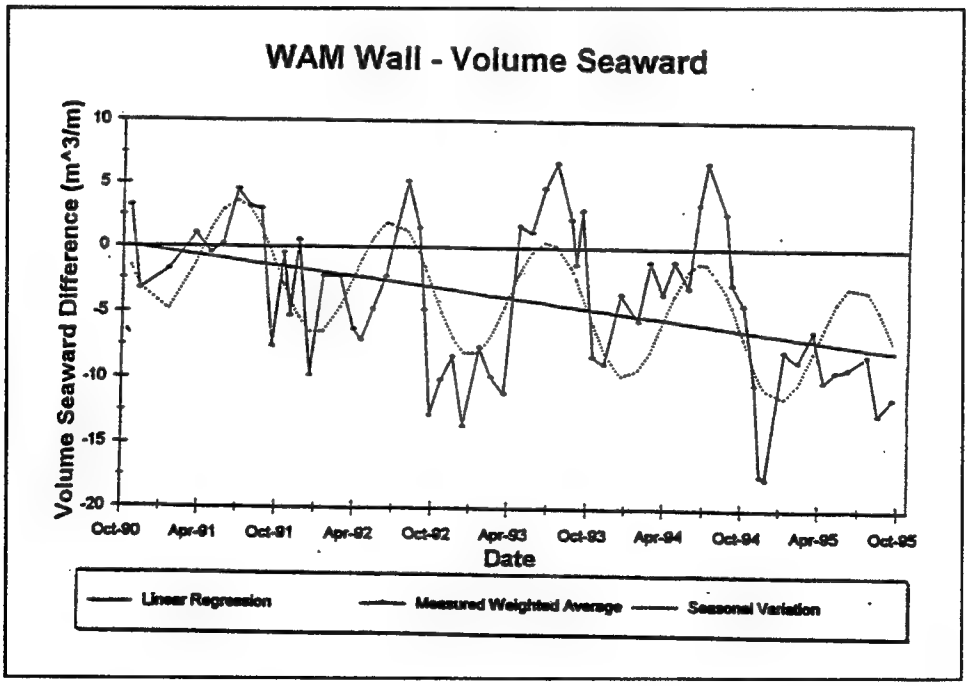


Figure 12. Volume seaward difference versus time for walled sections using weighted average method (WAM) for 5 full wave years (Oct 1990 - Sep 1995)

3.8 m^3/m (variance = 13.9) for the dunes and 4.7 m^3/m (variance = 19.7) for the walled sections. It appears that the seawalls act as a barrier for landward sand transport during summer seasons and that they also produce greater seasonal variations in sand volumes on the subaerial beach. These results are summarized in Table 4.

Table 4
Summary of 5 Years of ODU Data Profile Parameter DIFFERENCES and Seasonal Variations - WAM

Profile Parameter	Type	Rate of Change Five Wave Years Oct. 90-Sept. 95	Amplitude, a	Variance, σ^2	Starting Value October 1990
Volume Seaward Difference ΔV_S (m^3/m)	WALL	-1.58	4.7	19.7	25.3
	DUNE	-1.80	3.8	13.9	43.9
Volume Landward Difference ΔV_L (m^3/m)	DUNE ONLY	-1.75	4.93	16.4	148.7
Berm Elevation Difference ΔE_B (m)	WALL	-0.12	0.35	0.13	1.6
	DUNE	-0.09	0.23	0.04	2.1
Shoreline Position Difference ΔP (m)	WALL	+0.33	3.0	12.6	43.3
	DUNE	-0.48	2.7	10.3	56.7

Units: Volume per unit length, m^3/m, slope = $m^3/m/yr$
Elevation or distance, m, slope = m/yr

The time for beach "recovery" from the winter to summer season is herein defined as the time when the ΔV_S volume passes from below to above the linear regression line. The walls recovered earlier in 1991 and later than the dunes in 1992. Both types recovered at the same time in 1993 and 1994. In 1995, the severely eroded beach never quite recovered in front of the walls while the dunes eventually did recover near the end of the summer season. Conversely, the beach "erosion" from summer to winter season occurred simultaneously for both types in 1990, 1992, 1993, and 1994. In 1991 and 1995, the volume seaward difference occurred earlier for the dune sections.

Individual storms and post-storm recovery collectively determine the severity of the winter season. Also important are the duration of individual storms and their type, hurricanes or northeasters. While a hurricane may produce higher winds and greater storm surge, it usually passes over the area quickly. In contrast, a less violent and slower moving northeaster may cause more damage by elevating water levels along the shoreline for several tidal cycles. Seven significant storm events were included in this study, including three

northeasters and four hurricanes. Data for the first northeaster was obtained by the Virginia Institute of Marine Science in 1989 for the south end only. The other six events were recorded during the course of the ODU monitoring from 1990 to 1995 and include data for the entire Sandbridge study area. Post-storm surveys were performed by the ODU team within a day or two after the passing of each storm, as soon as the weather and surf would safely allow.

Using the WAM data, the walls experienced a greater loss of seaward volume than the dunes during three of the four hurricane events recorded at Sandbridge since 1989 (Table 5, Nos. 3, 5, 6, and 7). Surveys taken approximately one month after each storm indicate that the nonwalled profiles always recovered faster than the walls following the hurricane events, while the walls always recovered faster than the dunes after northeasters (Table 5, Nos. 1, 2, and 4). A comparison of the volume landward for nonwalled profiles revealed that the erosion rates were indeed greater during northeasters than during the shorter-lived hurricane events. The two extra-tropical, "northeaster" storm events (Table 5, Nos. 2 and 4) were of relatively long duration (H_{mo} greater than 2 m in 8-m depth at Duck, NC, for more than 100 hr, continuous) so that both walled and nonwalled profiles experienced roughly similar volume seaward reductions. But now the walls recovered faster to values equal to (or greater) than prestorm values after one or two months. The dunes had yet to recover to prestorm values for both seaward and landward volumes.[1]

Hurricane Gordon stalled off the Virginia coast in November 1994, resulting in damage to some of the seawalls and severe erosion of the nonwalled dunes. The 1995 summer rebuilding months were characterized by an unusually strong hurricane season in the Atlantic, including a close encounter with Hurricane Felix, which also stalled offshore in August. The combination of stormy winter and summer seasons prohibited the beach from recovering normally in the 1994-1995 wave year. This trend is shown clearly in Figures 11 and 12. There is very little published research on the required water level and wave climatology for beach rebuilding. These results for individual storms lend additional support for the walls producing greater seasonal variations in seaward sand volumes as measured by the amplitude a.

Other parameters

The volume landward *difference* ΔV_L for the WAM dune sections is shown as Figure 13 and Tables 4 and 5 for all three time scale trends. The linear regression slope was -1.75 m^3/m of negative volume change landward of the "partition," which was nearly the same as the seaward volume. The seasonal amplitude variation was slightly larger (4.93 m^3/m) and the storm volume change was also generally larger (more negative) than the seaward volumes. Comparisons with volume landward differences for the walled sections are

[1] These trends are also generally found in the March 1989 northeaster (Hardaway and Thomas 1990) as summarized in Table 5, No. 1, but only for the south end section using the simple average method (SAM) (see Hazelton (1994)).

Table 5
Storm Variations - WAM

No.	Storm Name (dates)	Survey Dates			Volume DIFFERENCE [1] Seaward, ΔV_S, m^3/m		Volume DIFFERENCE Landward ΔV_L, Dunes	Berm Elevation DIFFERENCE E_B, m		Shore Position DIFFERENCE P, m		RMKS
		Pre-Storm	Post-Storm	Recovery	Dunes (recovery)	Walls (recovery)		Dune (recovery)	Wall (recovery)	Dune (recovery)	Wall (recovery)	
1	[2]Northeaster Mar 7-11, 1989	02/17	03/10	03/21	-1.3 (+2.3)	-3.4 (+3.3)	-17.2 (-4.8)	-0.5 (+0.1)	-0.6 (+0.2)	-8.5 (+2.0)	-2.4 (+3.2)	[2]SAM Section 3 Only
2	Halloween Northeaster Oct 30-31, 1991	10/18	11/01	11/22	-5.0 (-2.3)	-4.8 (+1.0)	-6.5 (-8.0)	-0.2 (-0.1)	-0.3 (+0.1)	-3.0 (+1.1)	-3.5 (+2.2)	Recovery (difference) values are shown in parentheses
3	Hurricane Danielle Sep 22-25, 1992	09/11	09/27	10/23	-4.5 (-2.5)	-8.0 (-5.3)	-7.8 (-6.3)	-0.3 (-0.2)	-0.9 (-0.7)	-8.4 (-7.8)	-0.1 (+0.3)	
4	Northeaster Dec 12-15, 1992	11/13	12/18	01/23/93	-4.5 (-0.5)	-5.3 (+0.7)	-11.3 (-5.3)	-0.3 (-0.1)	-0.7 (-0.5)	-3.2 (-1.5)	-2.2 (+0.1)	
5	Hurricane Emily Dec 30-31, 1993	08/17	09/03	09/13	+2.5 (+1.7)	-3.0 (+0.3)	-1.8 (-0.8)	-0.1 (0)	-0.2 (0)	+2.7 (+2.1)	-1.7 (+0.6)	
6	Hurricane Gordon Nov 15-18, 1994	11/4	11/20	12/2	-3.8 (-5.8)	-7.0 (-7.3)	-10.5 (-8.3)	-0.4 (-0.4)	-0.6 (-0.6)	-5.0 (-6.5)	-2.7 (-2.7)	
7	Hurricane Felix Aug 16-18, 1995	7/25	8/21	9/22	-8.3 (-5.2)	-4.5 (-3.2)	-6.3 (-3.5)	-0.3 (-0.3)	-0.7 (-0.5)	-4.1 (-4.1)	-1.3 (-0.80)	

[1] Values shown are DIFFERENCE between post-storm and recovery date values relative to prestorm conditions.
[2] VIMS (Hardaway and Thomas 1990) Section 3 only at south end and using the simple average method (SAM) (see Hazelton (1994)).

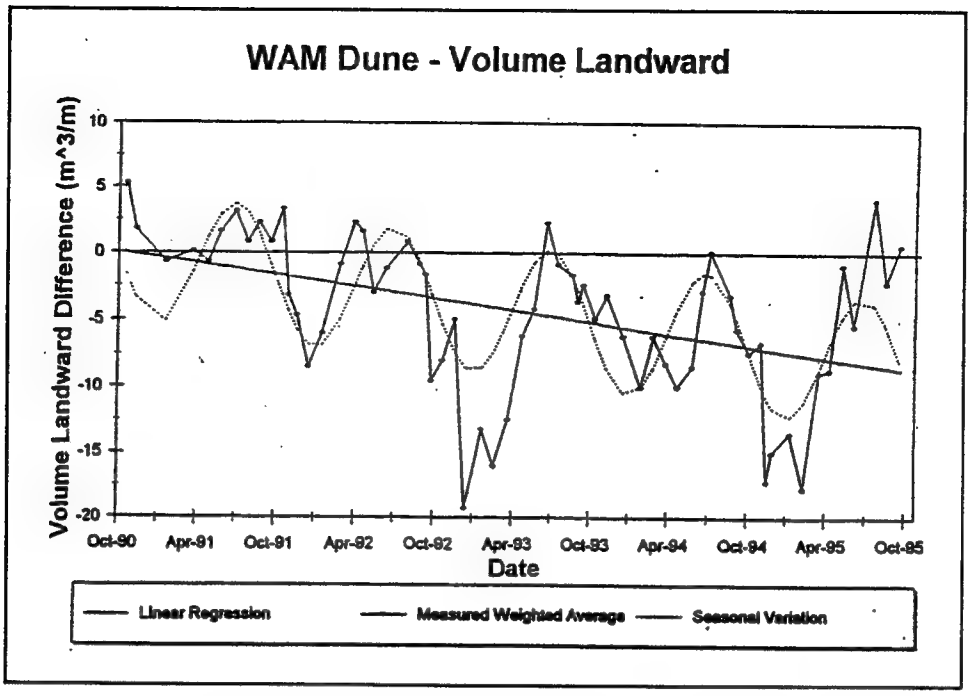


Figure 13. Volume landward difference versus time for nonwalled sections using weighted average method (WAM) for 5 full wave years (Oct 1990 - Sep 1995)

meaningless because these volumes are artificially manipulated and affected by different natural forces (wave overtopping and water runoff).

Similar plots (see Appendix A) of berm elevation *difference* ΔE_B for both walled and nonwalled WAM results show seasonal and storm/recovery trends that generally follow those presented above. The actual results are summarized in Tables 4 and 5. These results generally support the results discussed above for ΔV_S for all three time scales (5 years, seasonal, and storms) and the differences between walled and nonwalled beaches.

The shoreline position *difference* ΔP for the wall sections shows a slightly positive rate of change (+0.33 m/year) over the 5 years of ODU monitoring, while the dune sections reflect a slightly negative trend (-0.48 m/year). The plots for ΔP are also presented in Appendix A.

Change Rates for Various Analysis Methods

Weighted average method (WAM)

Trends in monthly survey results at Sandbridge as summarized by the WAM for sand volumes (m^3/m) are reproduced in Figures 14 and 15 for the nonwalled and walled profiles, respectively. All three (seaward, landward, and total) volume change trends for dunes are negative and indicate seasonal

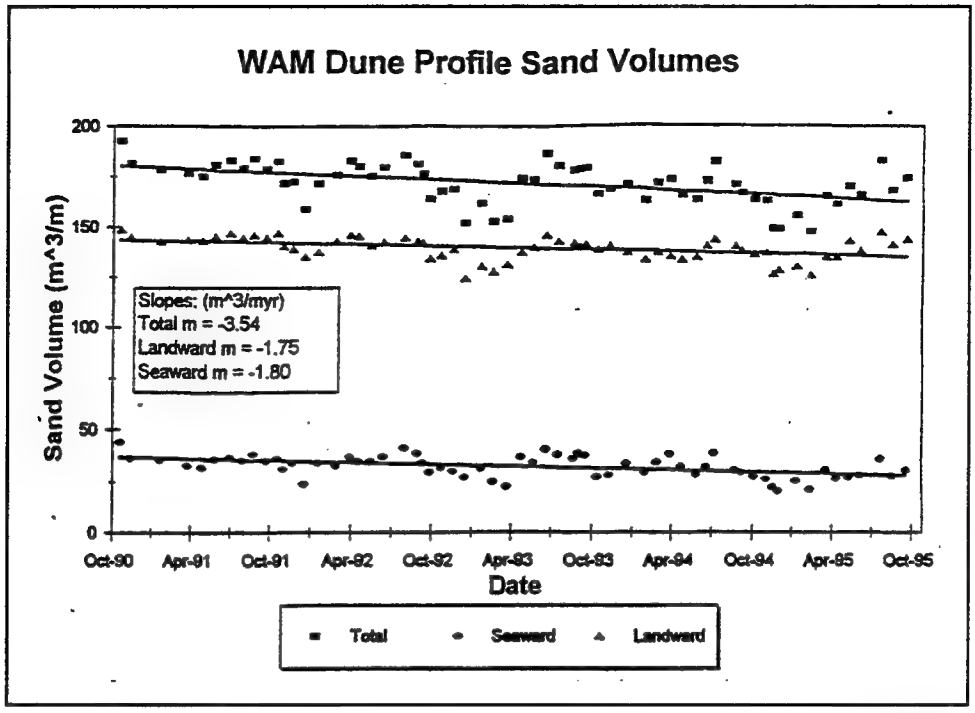


Figure 14. Subaerial sand volumes (per unit length) versus time for nonwalled sections using weighted average method (WAM) for V_S, V_L, and V_T for 5 full wave years (Oct 1990-Sep 1995)

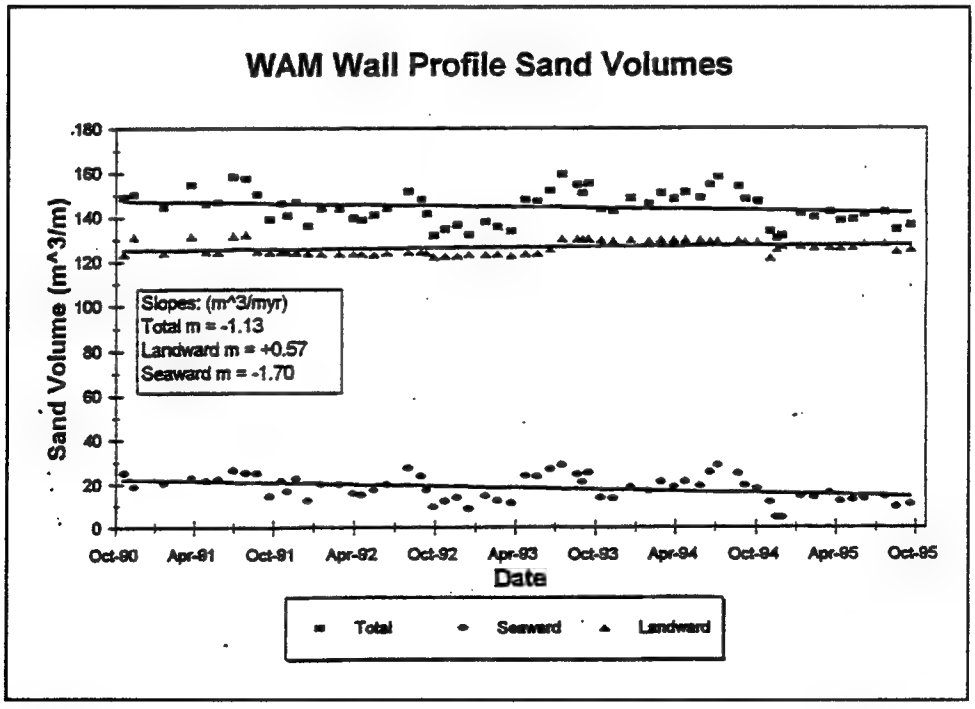


Figure 15. Subaerial sand volumes (per unit length) versus time for walled sections using weighted average method (WAM) for V_S, V_L, and V_T for 5 full wave years (Oct 1990 - Sep 1995)

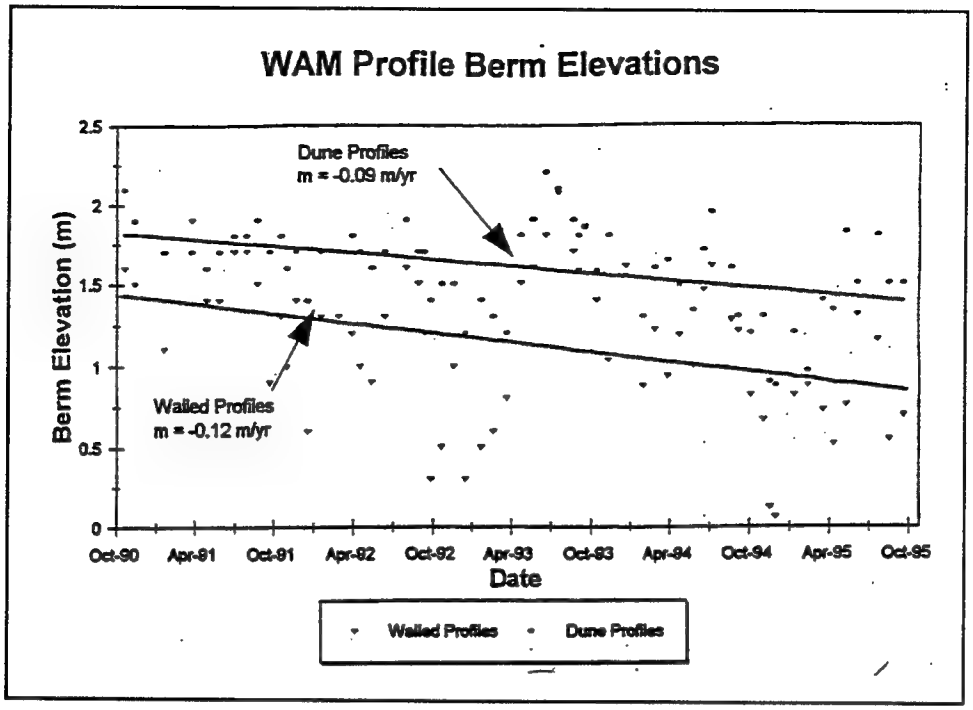


Figure 16. Profile berm elevation versus time for nonwalled and walled sections using weighted average method (WAM) for 5 full wave years (Oct 1990 - Sep 1995)

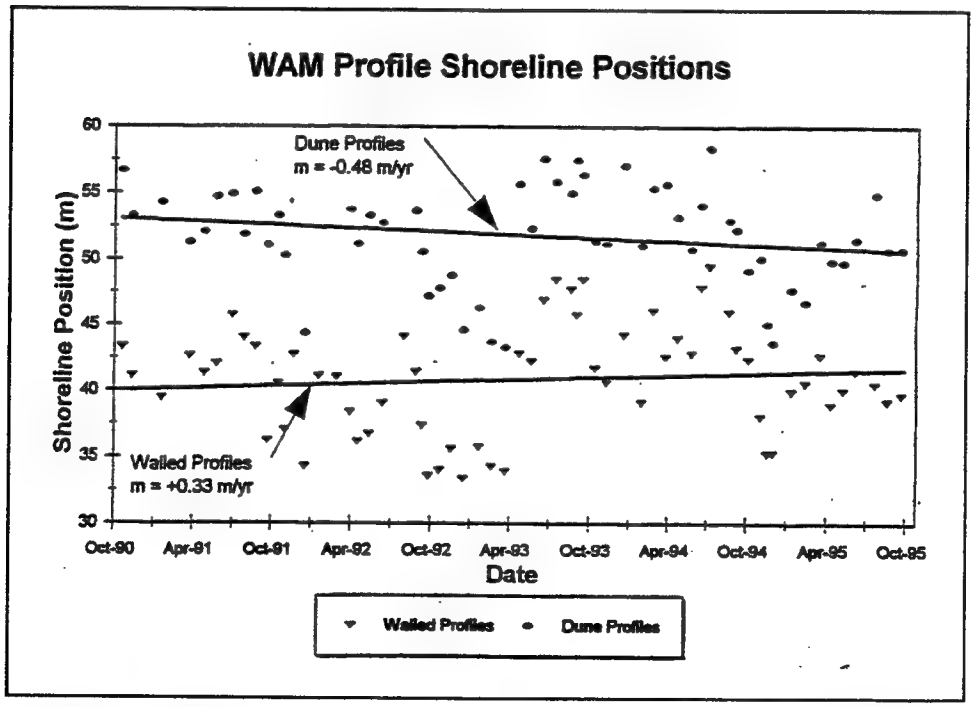


Figure 17. Shoreline position versus time for nonwalled and walled sections using weighted average method (WAM) for 5 full wave years (Oct 1990 - Sep 1995)

variations. Figures 16 and 17 show the berm elevation (E_B) and shoreline position (P) trends, respectively, for both boundary types (nonwalled and walled). The scatter in the E_B and P values is evident in these figures and obscures the seasonal trend. Volume change presents a clearer picture of subaerial beach change over time because it removes smaller scale variations and artificial beach manipulation (beach scraping) from the signal.

The parameter change rates for all five beach profile parameters are summarized in Table 6 using linear regression. Yearly change rates are shown for multiple years of data. In general, the change rates for the dune parameters are negative for each year. The wall parameters also follow a negative trend each year, with some notable exceptions. Volume landward for the walls had a positive change rate in the last two years of the study (+1.06 in 1994 and +0.54 in 1995). Wall construction on the north end at profile 13 was completed in September 1993, and the appropriate changes were made in the WAM model to reassign wall and dune lengths to reflect the actual study area conditions. This resulted in a slight increase of volume landward for the walled sections after September 1993 as seen in Figure 15. The shoreline position change rate for the walled sections was also positive over the last 3 years of the study. The measured data for shoreline position show a large variability from month to month, and are influenced greatly by local short-term wave and water level changes in addition to beach scraping and other human activity. Since the other parameters are negative over this same time period, it is concluded that this parameter provides an unreliable indicator of the erosion trends of this beach.

After 5 full years of data characterized by two mild winter seasons, two stormy winter seasons, and a summer season without normal recovery, the walled and nonwalled sections experienced seaward volume loss rates that are statistically *equal* (see Table 7). The rates of decrease in berm elevations and shoreline position were also statistically the same for both profile types. These results, using profile data that were "weighted" and "averaged" over the entire study area, are contrary to popular belief.

Appendix A summarizes the WAM parameter values for the dune and walled sections, respectively, for each of the 62 surveys used in the ODU data set.

Sectional weighted average method (WAMSECT)

For this analysis, the study area was divided into three sections (north end, middle section, south end) based on regional differences in historic erosion rates and baseline elevations (see Figure 6). The profiles used for each section were then averaged using a similar weighting process as the WAM. The purpose of the WAMSECT was to investigate the beach parameter rates of change on a more localized level. After 5 full wave years, the WAMSECT change rates are summarized in Table 8 for both walled and nonwalled sections. The profile numbers employed for each section are also shown. Appendix B

Table 6
WAM Parameter Rates of Change

WAM Beach Parameter		Wall	Dune	Difference
V_t change rate (m^3/m/yr)	1 Year	0.07	-5.66	5.73
	2 Years	-4.27	-3.97	-0.30
	3 Years	-0.85	-3.81	2.96
	4 Years	1.11	-3.12	4.23
	5 Years	-1.04	-3.54	2.50
V_s change rate (m^3/m/yr)	1 Year	-0.26	-4.09	3.83
	2 Years	-1.85	-1.08	-0.77
	3 Years	-0.61	-0.68	0.07
	4 Years	0.05	-0.96	1.01
	5 Years	-1.58	-1.80	0.22
V_l change rate (m^3/m/yr)	1 Year	0.39	-1.41	1.80
	2 Years	-2.46	-2.90	0.44
	3 Years	-0.25	-3.17	2.92
	4 Years	1.06	-2.16	3.22
	5 Years	0.54	-1.75	2.29
E_b change rate (m/yr)	1 Year	-0.16	-0.20	0.04
	2 Years	-0.18	-0.11	-0.07
	3 Years	-0.03	-0.02	-0.01
	4 Years	-0.02	-0.05	0.03
	5 Years	-0.12	-0.09	-0.03
P change rate (m/yr)	1 Year	-0.44	-2.26	1.82
	2 Years	-1.94	-1.32	-0.62
	3 Years	0.36	-0.50	0.86
	4 Years	1.31	0.23	1.08
	5 Years	0.33	-0.48	0.81

presents the WAMSECT plots of each region for both profile types over the full 5 years of study.

North end. At the north end, analysis shows that the volume seaward (V_S) rates of change for dunes and walls are negative and statistically equivalent (see Table 7). In addition, the amplitudes of the calculated seasonal variation are also equivalent. The regression slopes for berm elevation (E_B) and shoreline position (P) exhibit the same negative trends as V_S for the north end.

The volume landward (V_L) trend for nonwalled profiles possessed the greatest rate of change (-5.0 m^3/myr) and seasonal amplitude (9.1 m^3/myr) for the

Table 7
Null Hypothesis Tests

WAM Null Hypothesis Test

Parameter	Walled Profiles			Dune Profiles			Z value	Result
	X_1	N_1	v_1	X_2	N_2	v_2		
V_{S_3} (m^3/myr)	-1.58	62	19.73	-1.8	62	13.94	0.299	Statistically Equal
P (m/yr)	+0.33	62	12.64	-0.48	62	10.32	1.331	Statistically Equal
E_B (m/yr)	-0.12	62	0.127	-0.09	62	0.0397	-0.579	Statistically Equal

WAMSECT Null Hypothesis Test

North End

Parameter	Walled Profiles			Dune Profiles			Z value	Result
	X_1	N_1	v_1	X_2	N_2	v_2		
V_{S_3} (m^3/myr)	-1.44	63	65.57	-1.14	63	33.03	-0.240	Statistically Equal
P (m/yr)	-0.68	63	37.23	-1.19	63	27.54	0.503	Statistically Equal
E_B (m/yr)	-0.09	63	0.2	-0.09	63	0.1	0.000	Statistically Equal

Middle Section

Parameter	Walled Profiles			Dune Profiles			Z value	Result
	X_1	N_1	v_1	X_2	N_2	v_2		
V_{S_3} (m^3/myr)	-0.6	63	51.6	-1.5	63	23.5	0.825	Statistically Equal
P (m/yr)	-0.19	63	27.7	-1.37	63	9.39	1.537	Statistically Equal
E_B (m/yr)	-0.06	63	0.36	-0.03	63	0.05	-0.372	Statistically Equal

South End

Parameter	Walled Profiles			Dune Profiles			Z value	Result
	X_1	N_1	v_1	X_2	N_2	v_2		
V_{S_3} (m^3/myr)	-3.2	63	9.7	-4.03	63	20.1	1.207	Statistically Equal
P (m/yr)	-2.06	63	4.6	-2.67	63	10.5	1.248	Statistically Equal
E_B (m/yr)	-0.36	63	0.19	-0.24	63	0.05	-1.944	Statistically Equal

Table 8
WAMSECT Parameter Rates of Change

Profile Parameter Differences	Profile Type	Subsection: North End Profiles 1 - 54 Oct 90 to Sept 95		Middle Section Profiles 60 -162 Oct 90 to Sept 95		South End Profiles 179 - 252 Oct 90 to Sept 95	
		Rate of Change	Seasonal Amplitude	Rate of Change	Seasonal Amplitude	Rate of Change	Seasonal Amplitude
ΔVs (m^3/myr)	Wall	-1.44	-5.6	-0.61	-6.8	-3.20	-2.5
	Dune	-1.14	-5.2	-1.50	-3.6	-4.0	-3.9
ΔVl (m^3/myr)	Dune Only	-5.0	-9.1	+0.46	-4.6	-2.8	-4.2
ΔEb (m/yr)	Wall	-0.09	-0.4	-0.06	-0.3	-0.36	-0.4
	Dune	-0.09	-0.3	-0.03	-0.2	-0.24	-0.2
ΔP (m/yr)	Wall	-0.68	-3.6	-0.19	-3.1	-2.1	-1.7
	Dune	-1.19	-3.9	-1.37	-1.5	-2.7	-2.7
Sectional make-up		75% walled		44% walled		73% walled	
		25% nonwalled		56% nonwalled		27% nonwalled	

three subsections. It should be noted, however, that the dune located at profile 1 was leveled by the lot owner in the summer of 1994. Destruction of the dune significantly reduced the volume of sand landward of the imaginary partition for this section (nonwalled profiles account for only 25 percent of north end), thereby artificially increasing the negative regression trend for V_L in the north end.

Beach recovery following the winter season occurred simultaneously for both profile types for three years (1990 to 1993). The walled profiles recovered first in the 1993-1994 wave year. Wave year 1994-1995 was characterized by two hurricanes along the mid-Atlantic coast (Gordon, November 1994 and Felix, August 1995) in addition to a stronger wave climate generated by hurricane activity in the Carribean. While the nonwalled profiles eventually recovered, data show that V_s for the walled profiles never recovered above the regression line for this section (see pages B6 and B7).

Both profile types made the transition from "summer" to "winter" characteristics (seasonal erosion) around the same time for the first 4 years of the ODU study (1990-1994). During the stormy 1994-1995 season, the dunes made the transition first.

Middle section. Regression analysis of the WAMSECT model for the middle section shows that the rates of change for V_S, E_B, and P are statistically equivalent for both walled and nonwalled profiles (see Table 7). Seasonal

amplitudes of these beach parameters are slightly greater for the walled profiles.

The volume landward rate of change for the nonwalled profiles was slightly positive for this section (+0.46 m^3/myr) over the 5-year period. The middle section is almost equally divided in length between walls (44 percent) and dunes (56 percent). Evidence of beach scraping and sand dumping along the dune profiles of this section has been observed and recorded on numerous occasions by the ODU survey team during the course of this study. The authors believe that the frequent occurrence of these activites created the positive trend demonstrated by the analysis, not a landward shift of material due to aeolian transport or other natural mechanisms.

Beach recovery occurred simultaneously for both profile types in the first 3 wave years (1990-1993). The walled profiles recovered before the nonwalled profiles in the 1993-1994 summer season. Like the north end, the walled profiles never recovered above the regression line following the stormy 1994-1995 season (see pages B8 and B9).

Transition from summer to winter levels occurred first for the walled profiles in 1990-1991. Both profile types changed at the same time in the 3 years between 1991 and 1994. The nonwalled profiles eroded to winter levels before the walls in the turbulent 1994-1995 wave year.

South end. As in the north end and middle section, the rates of change for V_S, E_B, and P in the south end are statistically equivalent for both walled and nonwalled profile types (see Table 7). In contrast to the middle section, the calculated seasonal amplitudes for these parameters were slightly greater for the nonwalled areas.

The south end is 73 percent walled and 27 percent nonwalled (similar to the north end). The nonwalled V_L regression trend was -2.8 m^3/myr and was similar to the rates observed for V_S (-3.2 m^3/myr walled, -4.0 m^3/myr nonwalled) in this section.

The walled profiles recovered first during the summer beach rebuilding season for the first 2 years of the study (1990-1992). In the 1990-1991 season, however, the nonwalled profiles did not recover above the V_S regression line (see pages B10 and B11). In the remaining 3 years of the ODU study, both profile types recovered simultaneously. Seasonal transition from summer to winter occurred at the same time for walled and nonwalled profiles for 1990-1994. The 1994-1995 season shows that the walls eroded to winter levels before the dunes, conflicting the trends observed for this wave year in the north and middle regions.

Simple average method (SAM)

Hazelton (1994) divided the Sandbridge study area into three sections similar to the north end, middle section, and south end used in the WAMSECT analysis. Profile "weights" were omitted from the averaging process to produce simple average trends in the beach parameters. The SAM analysis was performed using 4 full wave years of ODU data (1990 to 1994). Unlike the WAMSECT results, Hazelton's SAM shows that the volume seaward rates of change are positive for the north end and middle sections, suggesting that sand eroded from the south end is being deposited up the coastline on the other sections. SAM results agree with the positive volume landward rate of change for the middle section found using the WAMSECT. Complete details of the SAM analysis and results can be found in Hazelton (1994).

Statistical analysis results

Statistical comparison of parameter change rates (V_S, P, E_B) using the null-hypothesis test revealed that the erosional trends are *statistically equal* for walled and nonwalled profiles for all parameters. The results are the same for the WAM analysis and for each section in the WAMSECT analysis. Using 5 years of statistical data, there is no evidence to support the conclusion that seaward volumes in front of seawalls are disappearing any faster than seaward volumes in front of nonwalled profiles. Differences in the P and E_B rates of change for walled and nonwalled profiles must also be considered statistically equal, despite the large amount of scatter in the P and E_B data. These results are presented for the WAM and WAMSECT analyses in Table 7.

As an example, consider the V_S parameters for the middle section. The required information to perform the Z-Test is:

a. Walled profiles.

(1) X_1, V_S parameter for walls = -0.6 m^3/myr.

(2) N_1, number of observations = 63.

(3) v_1, variance of measured data about the seasonal regression line (EQN 3) = 51.6.

b. Dune profiles.

(1) X_2, V_S parameter for dunes = -1.5 m^3/myr.

(2) N_2, number of observations = 63.

(3) v_2, variance of measured data about the seasonal regression line (EQN 3) = 23.5.

Using Equation 4 to calculate the Z-test statistic:

$$Z = (X_1 - X_2)/\sqrt{(v_1/N_1 + v_2/N_2)}$$

$$= (-0.6 + 1.5)/(\sqrt{(51.6/63 + 23.5/63)})$$

$$= 0.824$$

Since the Z statistic falls within the allowable range for the 95-percent confidence interval (-1.96 to +1.96), one can accept the null-hypothesis and say that the change rates for the dune and wall populations are statistically equal. To further illustrate this example, one can determine what value the differences in regression slopes must be to reject the null-hypothesis:

$$P\ [-1.96 < Z < +1.96] = 0.95$$

$$P\ [-1.96 < (X_1 - X_2)/\left(\sqrt{v_1/N_1 + v_2/N_2}\right) < +1.96] = 0.95$$

$$P\ [-1.96\ \left(\sqrt{(v_1/N_1 + v_2/N_2)}\right) < (X_1 - X_2) + 1.96\left(\sqrt{(V_1/N_1 + V_2/N_2}\right)] = 0.95$$

$$P\ [-1.96(1.092) < (X_1 - X_2) + 1.96(1.092)] = 0.95$$

$$P\ [-2.14 < (X_1 - X_2) < +2.14] = 0.95$$

In other words, the difference in the parameter regression slopes must lie outside the range $-2.14 < (X_1 - X_2) < +2.14$ for the null-hypothesis to be rejected in favor of the alternate hypothesis (i.e. the rates of change for walls and dunes are statistically different).

Individual profile method (IPM)

Only when individual profiles are considered can the full data set be utilized dating back to October 1980. Profile locations varied and were not sufficient in number before August 1990 to permit averaging methods. When WAM or WAMSECT analyses were attempted, large increases and decreases in the profile parameters were detected that were the result of the number of profiles employed in the analysis and/or profile location variability and were not representative of actual physical changes in the data. Consequently, the individual profile method (IPM) was felt to be the only way to study changes in the parameter change rates before and after seawall construction.

Thirty-four individual profiles were identified for analysis that included six locations with sufficient data to be included along with the 28 profile locations in the ODU data set. These profiles are summarized in Table 9 and in some

Table 9
IPM Analysis Summary of Beach Parameter Change Rates

Profile Number	Type	Regression Dates	# Yrs	# Surveys	V_{T_3} (m^3/myr)	V_{S_3} (m^3/myr)	V_{L_3} (m^3/myr)	E_B (m/yr)	P (m/yr)
1 before	Dune	10/80 to 7/88	8	24	+0.3	-0.5	+0.8	-0.0	-0.1
1 after	Dune	7/89 to 6/94	5	58	-11.1	-2.1	-9.0	-0.1	-0.9
13 before	EOW	5/91 to 4/93	2	34	-14.4	-0.1	-14.3	-0.2	-0.7
13 after	Wall	5/93 to 4/94	1	29	-13.7	-12.4	-1.3	-0.4	-7.5
20	Wall	10/90 to 9/95	5	63	-1.8	-2.4	+0.6	-0.2	-1.6
25 before	Dune	10/80 to 9/88	8	24	+0.3	+0.7	-0.4	+0.1	+0.0
25 after	Wall	10/90 to 9/95	5	72	-7.0	-1.7	-5.3	-0.1	+0.0
41	Wall	10/90 to 9/95	5	69	-0.2	-0.7	+0.5	+0.0	-0.2
46	EOW	10/90 to 9/95	5	64	+1.7	+0.4	+1.2	-0.0	+0.7
47	Dune	10/90 to 9/95	5	63	-4.9	+0.5	-5.4	-0.0	+0.1
54	Dune	10/90 to 9/95	5	64	-5.9	-1.4	-4.5	-0.1	-1.6
60 before	Dune	10/80 to 7/85	4	17	-11.4	-6.3	-5.1	-0.5	-1.4
60 after	Dune	10/90 to 9/95	5	62	-6.5	-0.8	-5.7	-0.1	-1.4
70	Wall	10/90 to 9/95	5	66	-1.1	-0.0	-1.1	-0.0	-0.2
74 before	Dune	10/80 to 9/88	7	30	-11.4	-10.7	-0.8	-0.4	-2.0
74 after	Wall	7/89 to 7/93	4	9	+1.4	+1.4	-0.1	+0.1	+0.9
78	Wall	10/90 to 9/95	5	69	+0.9	-0.6	+1.5	-0.1	-0.6
87	Wall	10/90 to 9/95	5	63	-0.9	-0.4	-0.6	+0.1	-0.3
103	EOW	10/90 to 9/95	5	60	-2.6	-3.0	-0.5	-0.0	-1.0
107	Dune	10/80 to 7/85	4	18	+10.1	+5.3	+4.8	+0.1	+1.9
118	Dune	10/90 to 9/95	5	61	-5.9	-2.5	-3.4	-0.0	-1.2
131	Dune	6/85 to 10/91	6	22	+13.3	+4.8	+8.6	+0.3	+1.6
135 before	Dune	10/80 to 9/88	8	24	+4.3	+1.4	+2.9	+0.0	+0.7
135 after	Dune	10/90 to 9/95	5	69	+5.4	+0.6	+4.8	+0.1	-0.2
148	Wall	10/90 to 9/95	5	62	-0.8	-0.7	-0.1	-0.3	-0.4
161 before	Dune	10/80 to 10/88	8	50	-4.2	-2.0	-2.2	-0.1	-1.0
161 after	Dune	10/90 to 9/95	5	70	-2.8	-2.0	-0.8	-0.1	-1.5
162	EOW	10/90 to 9/95	5	62	-4.7	-2.7	-2.0	-0.1	-2.4
179	Wall	10/90 to 9/95	5	59	-5.0	-4.0	-1.0	-0.1	-2.7
194 before	Dune	10/88 to 9/89	1	18	+3.9	+5.7	-1.9	+0.5	+4.3
194 after	Wall	10/90 to 9/95	5	64	-4.3	-3.1	-1.3	-0.4	-1.9
205	Dune	4/81 to 4/88	7	46	-6.0	-3.9	-2.1	-0.2	-1.7
207	Wall	10/90 to 9/95	5	60	-2.9	-2.2	-0.7	-0.3	-1.5
216 before	Dune	9/85 to 8/90	5	29	-7.6	-3.7	-3.9	-0.2	-2.4
216 after	EOW	10/90 to 9/95	5	65	-4.9	-1.4	-3.5	-0.2	-2.8
220 before	Dune	9/85 to 9/89	4	41	-16.5	-6.9	-9.6	-0.3	-3.9
220 after	Dune	10/90 to 9/95	5	65	-3.2	-0.4	-2.7	-0.1	-2.1
226	Wall	10/88 to 9/95	7	66	-4.0	-4.4	+0.4	-0.6	-2.6
230	Dune	10/88 to 9/95	7	80	-7.8	-4.0	-3.7	-0.2	-2.6
234	Wall	10/90 to 9/95	5	61	-5.9	-3.2	-2.7	-0.6	-1.8
240	EOW	10/90 to 9/95	5	62	-7.9	-5.0	-2.9	-0.2	-2.9
252 before	Dune	10/80 to 9/88	8	47	-2.1	-3.0	+0.9	+0.1	-1.5
252 after	Dune	10/90 to 9/95	5	71	-8.7	-7.2	-1.5	-0.4	-2.4

cases are split into two entries for "before" and "after" seawall construction at that same or nearby locations. The table lists profile type including some at the end-of-walls (EOW), and the number of surveys, years, and dates applicable for the linear regression analysis. The table presents change rates for the five profile parameters so that "before" and "after" seawall construction comparisons can be made. The profile comparisons were made in three groups (north, middle, and south) recognizing the different physical characteristics of these sections.

The key variable is the profile volume landward of the seawall or partition. A large decrease in the change rate V_L after adjacent wall construction means that Question No. 3 is supported, i.e., at one profile location, the volume of sand retained behind nearby walls is unavailable, causing adjacent, nonwalled locations to erode at a faster rate. Profile 1 is a good example, as shown in Figure 18 and Table 9. For 8 years (October 1980 - July 1988) and for 24 surveys, V_L "before" was +0.8 m^3/m/yr. Seawalls were constructed during the spring of 1989 about 30 m south on adjacent property so that for 5 years (July 1989 - June 1994) with 54 surveys the rate became -9.0 m^3/m/yr. In Table 9, available data spanning full wave years (winter and summer seasons) have always been used so that seasonal effects are removed, as the database

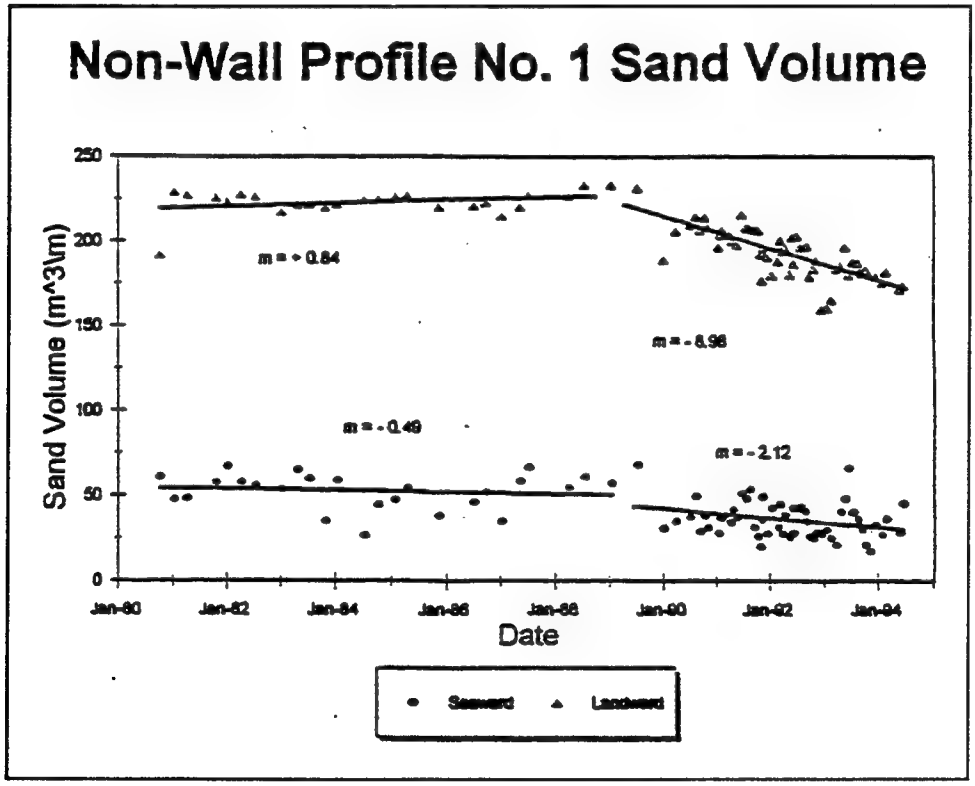


Figure 18. Subaerial sand volume (per unit length) versus time at nonwall profile No. 1 for V_S and V_L showing increase in landward volume change rate after nearby wall construction in 1990 (supporting evidence for Question No. 3)

permits. The date when walls were built also varies, so that the "before" and "after" time spans are not consistent for all profile comparisons.

Unfortunately, results for profile No. 1 after nearby wall construction are possibly contaminated by the lot owner bulldozing the dune so that the question remains as to how much effect the adjacent wall really has on these results. For this reason, the after-wall analysis was terminated after June 1994 at this location.

Using this IPM comparison for other profiles in the north end section, it is concluded that supporting evidence does exist for Question No. 3, as shown in Table 9. However, this is not true for the middle or south end sections.

As a conflicting example in the middle section for P161, Figure 19 shows a similar 8-year period (October 1980 - October 1988) and after 50 surveys, V_L "before" was -2.2 m^3/m/yr. Seawalls were built during 1989 starting 30 m south (P162), so that after 5 years and 70 surveys, the "after" rate became -0.8 m^3/m/yr. This evidence, and many other examples in the middle section, leads to the conclusion that the evidence is "nonsupporting" (Table 10). The

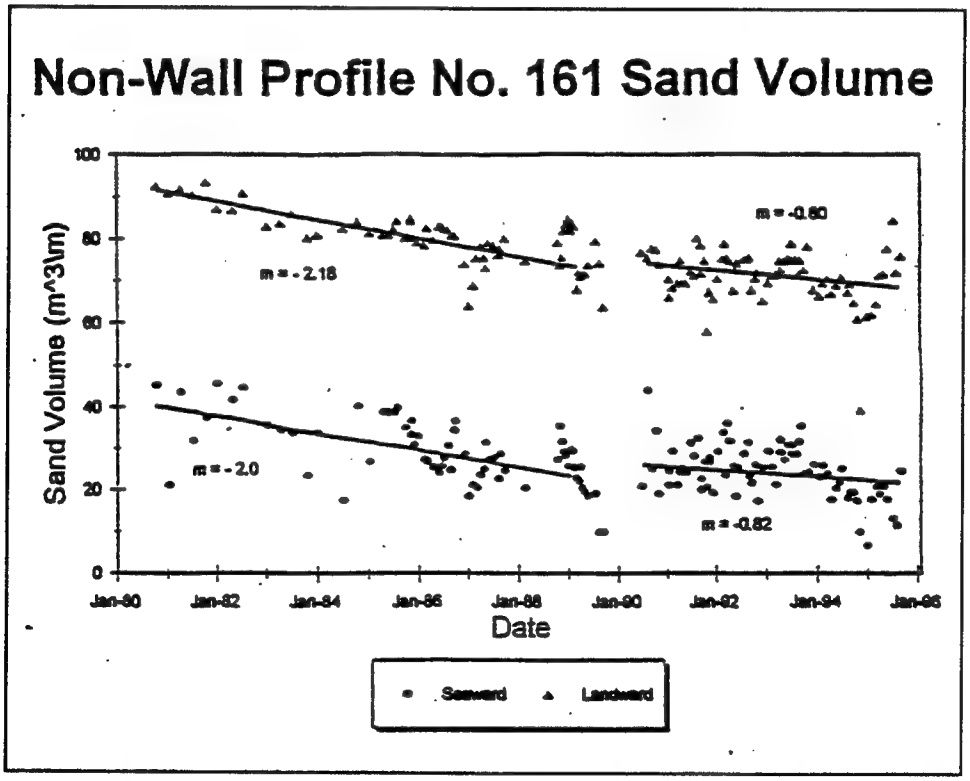


Figure 19. Subaerial sand volume (per unit length) versus time at nonwall profile No. 161 for V_S and V_L, showing no significant change in landward volume change rate after nearby wall construction in 1990 (nonsupporting evidence for Question No. 3)

Table 10
IPM Results

Location	Lengths, m (%)			Evidence[1]		Remarks
	Wall m, %	Dune m, %	Total m, %	Question No. 1 Volume Seaward	Question No. 3 Volume Landward	
North end	1,310 (78.8)	353 (21.2)	1,663 (21.6)	Inconclusive	Supporting (possibly)	
Middle section	1,420 (43.3)	1,862 (56.7)	3,282 (42.7)	Nonsupporting[2]	Nonsupporting	
South end	2,008 (73.1)	738 (26.9)	2,746 (35.7)	Inconclusive	Inconclusive	
Sandbridge Beach	4,738 (61.6)	2,953 (38.4)	7,691 (100)	Inconclusive	Inconclusive	

[1] Evidence
Supporting = Yes, evidence exists in support of Question No. 3.
NonSupporting = No, evidence does not exist.
Inconclusive = Either/or, no clear trend, conflicting evidence.
[2] The case should be made for the exact opposite - the volume seaward eroded faster for the dune profiles.

south end section includes supporting (P252), nonsupporting (P216, P220) and inconclusive evidence so that this evidence must be labeled inconclusive (Table 9). All the nonwalled profiles (except P252) are actually road/beach sections so that sand trapped beneath the road now also interferes with these results.

Profile P252 can be considered a "control" profile because it is over 350 m south of the nearest wall. For 8 years (October 1980 - September 1988) and using 47 surveys, the total volume change rate V_T was -2.1 m^3/m/year reflecting the historically high erosion rate on the southern end. Wall construction peaked in 1989, so that after a 5-year period (October 1990 - September 1995) of the ODU surveys, the total volume change rate V_T has more than quadrupled to -8.7 m^3/m/year. This "control" profile gives some supporting evidence to Question No. 3 on the south end of Sandbridge Beach.

Table 10 also displays analysis of the evidence surrounding Question No. 1 using the volume seaward change rates. In general, these results for the IPM give the same results as the sectional weighted average (WAMSECT), and weighted average (WAM) results. In fact, for the middle section, which is higher with more sand available, just the opposite trend could be argued from the data. The walls block onshore sediment transport, which causes larger volumes, higher berms, and wider profiles for some walled profiles. Appendix C presents plots of V_s and V_L for 34 profile locations showing "before" and "after" trends.

7 Summary

Scope and Limitations

The results summarized below are based on subaerial beach profiles taken at one Atlantic Ocean site that has experienced an average, historic erosion rate of about 2 m/year for more than 120 years before seawall construction. Fifteen years of survey data were employed, with eight to nine years of variable data taken before wall construction peaked in 1989. The main focus of these results is on 5 full wave years of monthly and post-storm survey data taken at 28 locations (16 walled and 12 nonwalled) since October 1990. Three time scales (historic, seasonal, storms) and three analysis methods were used to address three questions concerning the effects of seawalls on adjacent beaches.

QUESTION NO. 1
Does the sand volume seaward of walls erode faster than the volume seaward of the "partition" for nonwalled locations?

The results at three time scales and from the three analysis methods all supported the same conclusion, namely: the volume erosion rates are *not higher* in front of seawalls. Time scales and sectional differences revealed some interesting trends.

Sand eroding from the south end and middle section is drifting north to reduce the north end historic erosion rate. The elevated middle section actually shows evidence of the opposite trend, i.e., nonwalled locations eroded faster seaward of the partition in both the WAMSECT and IPM analyses.

The seasonal variability of the sand volume in front of walls is generally greater than at nonwalled locations. The walls create a relatively narrow and higher energy zone for winter season waves to drag more sand into the subaqueous region. The walls also block the onshore transport of sand so that relatively more sand returns during the summer season. The full wave year includes both winter storm waves and summer swell waves and must always be considered in the discussion of sand volume change rates at seawalls. Too much emphasis in the literature is focused on storm waves removing more sand at walled locations. Little mention is made of summer swell waves returning to pile more sand up against walls in beach rebuilding.

QUESTION NO. 2
Do seawalls delay beach recovery?

Using the WAM and WAMSECT results, seawalled beaches recovered about the *same time* as nonwalled locations. However, during the abnormally high energy 1994-1995 wave year, the nonwalled sections eventually recovered while the walled sections did not. Evidence shows that the beach transition from winter to summer volumes also occurs simultaneously for walled and nonwalled profiles. Over a 5-year period on three of five occasions the walls recovered at the same time or earlier for transition from winter to summer volumes. The walled sections recovered before the dunes following north-easter storms, but the dunes recovered earlier than the walls after hurricane events.

QUESTION NO. 3
Is the sand volume landward of the "partition" at nonwalled locations eroding at a faster rate after construction of adjacent seawalls?

Using the IPM, some supporting evidence was found for the north end. However, the middle section showed the opposite trend and the evidence was inconclusive for the south end except at the "control" profile (P 252), which also provided evidence to support Question No. 3. For Sandbridge as a whole, data were considered *inconclusive* through September 1995.

After wall construction, the sand trapped behind the wall is not available for transport to adjacent beaches during and after storm events. The loss of this sand volume is in its initial stages of detection at Sandbridge. More full wave years of profile data are needed to confirm and quantify the effect. Sand is also trapped beneath the road at nonwalled locations.

The intermittent walled and nonwalled reaches, lateral sand transport in both directions, and increased elevation of the mid-section all add considerable complexity to the Sandbridge site. These results might be different if, e.g., the central two-thirds section was a continuous wall, the barrier elevation was flat, and one dominant direction prevailed for littoral drift. There is no evidence of walls acting as groins to trap sand on the "up-drift" side.

8 Recommendations

Continued monitoring of the subaerial profile is strongly recommended. The ratio of the volume trapped to the volume remaining may be reaching a critical stage after which wall (and road) effects on adjacent beaches will be confirmed and quantified by this data set. Seasonal variability and recovery of sand volumes in front of walls will also be more completely understood. Clearly, only the volume profile parameters V_S and V_L quantify "volume" change and are far superior to berm elevation and shoreline position for characterization of dune/beach and wall/beach profiles.

Long before roads, houses, and seawalls were constructed at Sandbridge, the natural shoreline was receding on average about -2m/year. Where profile data are available to calculate volumes, the actual coastal erosion ratio R_V should be employed using Equation 2:

$$R_V = \frac{\dot{V}_A}{\dot{V}_N}$$

The goal of continued monitoring at Sandbridge is to quantify R_V for the north end, middle, and south end sections. The "level" of seawall impact on adjacent beaches (1 percent, 5 percent, 10 percent, 50 percent, etc.) needs quantification and may increase in time, i.e., $R_V(t)$ unless mitigation measures are introduced by adding new sand to replace that trapped behind the seawalls.

Quantification of R_V (1.01, 1.05, 1.10, 1.50, etc.) will permit some type of mitigation legislation to be enacted. Simply put, those homeowners constructing seawalls to protect upland property from storm damage would also be required to add a yearly quantity of sand to the beach. This additional sand would compensate for that removed from the system as quantified by $R_V>1$. As an example, assume it can be documented that $R_V = 1.10$, so that mitigation must add 10 percent more new sand per year. For a high recession rate of -2m/year, this converts to -16.5 m^3/m/year for beaches with closure depth at about -6.5 m and berm elevation of +2 m. For a Sandbridge lot 25 m wide, the additional sand required each year for mitigation would be about 40 m^3 (53 cy). For truck-handled sand at \$13/m^3 (≈\$10/cy), the annual "sand mitigation tax" would be about \$500 per year.

Clearly, as demonstrated above, the seawalls-versus-beaches controversy is not a clear-cut issue, especially where "natural" erosion existed before wall construction, as is the usual case. Additional seasonal volume fluctuation *in front* of seawalls is of concern for design. Quantification of R_V for property adjacent to seawalls will aid in development of mitigation legislation so that the full range of shore protection alternatives (hard, soft, sand traps and combinations) can *coexist* in the coastal zone.

References

Bellomo, D. A. (1993). "Statistical variations in beach parameter change rates for walled and non-walled profiles at Sandbridge, Virginia," M.S. thesis, Department of Civil and Environmental Engineering, Old Dominion University, Norfolk, VA.

Bethea, R. M., and Rhinehart, R. R. (1991). *Applied engineering statistics.* Marcel Dekker, Inc.

Birkemeier, W. (1984). "A user's guide to ISRP: The interactive survey reduction program," Instruction Report CERC-84-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Dean, R. G. (1986). "Coastal armoring: Effects, principles and mitigation." *Proc. 20th International Conference on Coastal Engineering*, Taiwan, Vol. 2, 1843-1857.

Dolan, R. (1985). "Sandbridge Beach and back bay," Tech. Rpt., Sandbridge Beach Restoration Association.

Everts, C. H., et al. (1983). "Shoreline movements; Report 1, Cape Henry, Virginia to Cape Hatteras, North Carolina, 1849-1980," Technical Report CERC-83-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Griggs, G. B., Tait, J. F., and Corona, W. (1994). "The interaction of seawalls and beaches: Seven years of field monitoring Monterey Bay, California," *Shore and Beach* 62(3), 21-28.

Hardaway, S. C., and Thomas, G. R. (1990). "Sandbridge Bulkhead impact study," Spec. Rpt. in *Applied Marine Science and Ocean Engineering*, No. 305, Virginia Institute of Marine Science.

Hazelton, J. M. (1994). "The influence of seawalls on beach response to storms, seasonal trends and long-term erosion," M.S. thesis, Department of Civil and Environmental Engineering, Old Dominion University, Norfolk, VA.

Kraus, N. C. (1988). "The effects of seawalls on the beach: An extended literature review," *Journal of Coastal Research*, Spec. Iss., No. 4, Autumn, 1-28.

Morton, R. A. (1988). "Interactions of storms, seawalls and beaches of the Texas Coast," *Journal of Coastal Research*, Spec. Iss., No. 4, Autumn, 113-134.

Pilkey, O. H. (1988). "Eroding shorelines impose costly choices," *Geotimes* 33(5), 11-13.

Pilkey, O. H., and Wright, H. L. (1988). "Seawalls versus beaches," *Journal of Coastal Research*, Spec. Iss., No. 4, Autumn, 41-64.

The Traverse Group, Inc. (1980). "Beach erosion control and hurricane protection at Virginia Beach, Virginia: Coastal process evaluation," Spec. Rpt. for Coastal Engineering Research Center, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS, August.

U.S. Army Corps of Engineers. (1985). "Sandbridge Beach, Virginia Beach, Virginia," Supplemental Preauthorization Study, Norfolk District Office.

U.S. Coast Survey. (1852). "Preliminary Sketch of Galveston Bay, Texas." Map drawn by A.D. Bache, syst., scale 1:200,000.

Wright, L. D., et al. (1987). "Shoreline and beach dynamics of the coastal region from Cape Henry to False Cape, Virginia," Virginia Institute of Marine Science Technical Report, September.

Bibliography

Basco, D. R. (1991). "Boundary conditions and long term shoreline change rates for the southern Virginia ocean coastline," *Shore and Beach* 59(4), 8-13.

Basco, D. R. (1992). "Some perspectives on the relative strengths of the March 1989 and October 1991 coastal storms at Sandbridge, Virginia," prepared for Pender & Coward, Attorneys and Counsellors at Law, June, 1992.

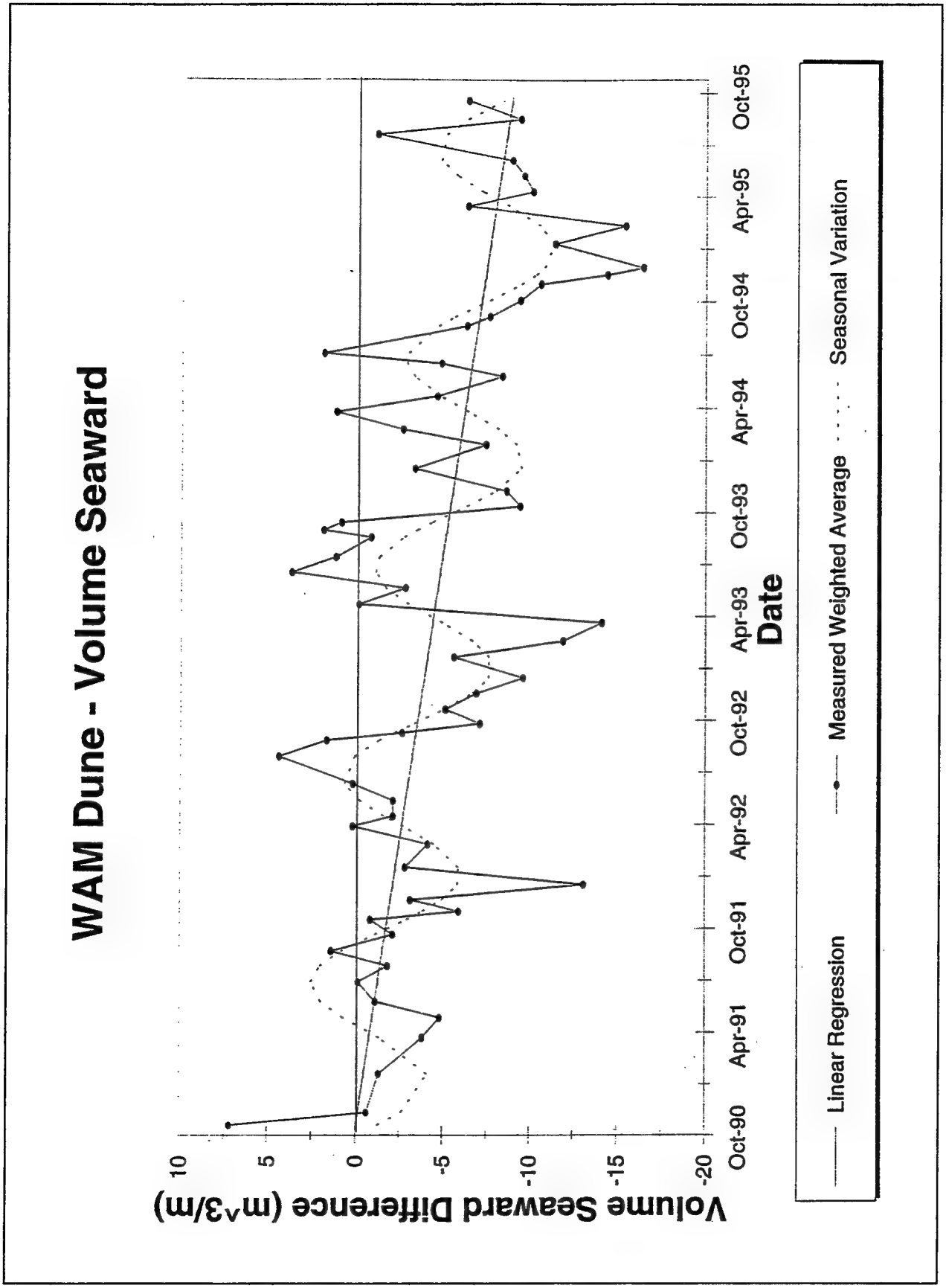
Basco, D. R., Bellomo, D. A., and Pollock, C. (1992). "Statistically significant beach profile change with and without the presence of seawalls." *Proc., 23rd International Conference on Coastal Engineering*, Italy, Vol. 2, 1924-1937.

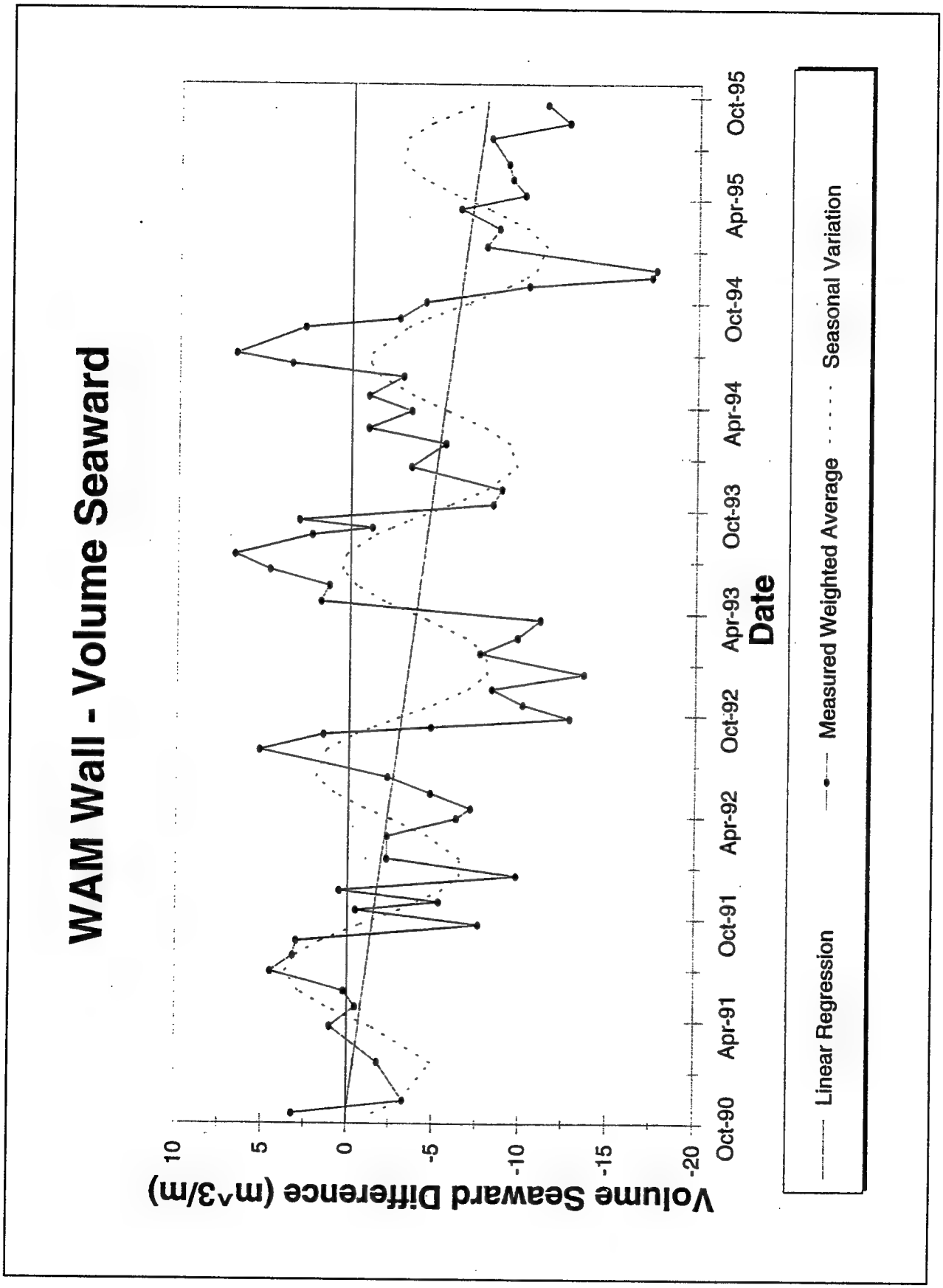
Basco, D. R., Hazelton, J. M., Bellomo, D. A., and Williams, G. (1994). "Preliminary statistical analysis of beach profiles for walled and non-walled sections at Sandbridge, Virginia." *Proc., 7th National Conference on Beach Preservation Technology*, Tampa, FL.

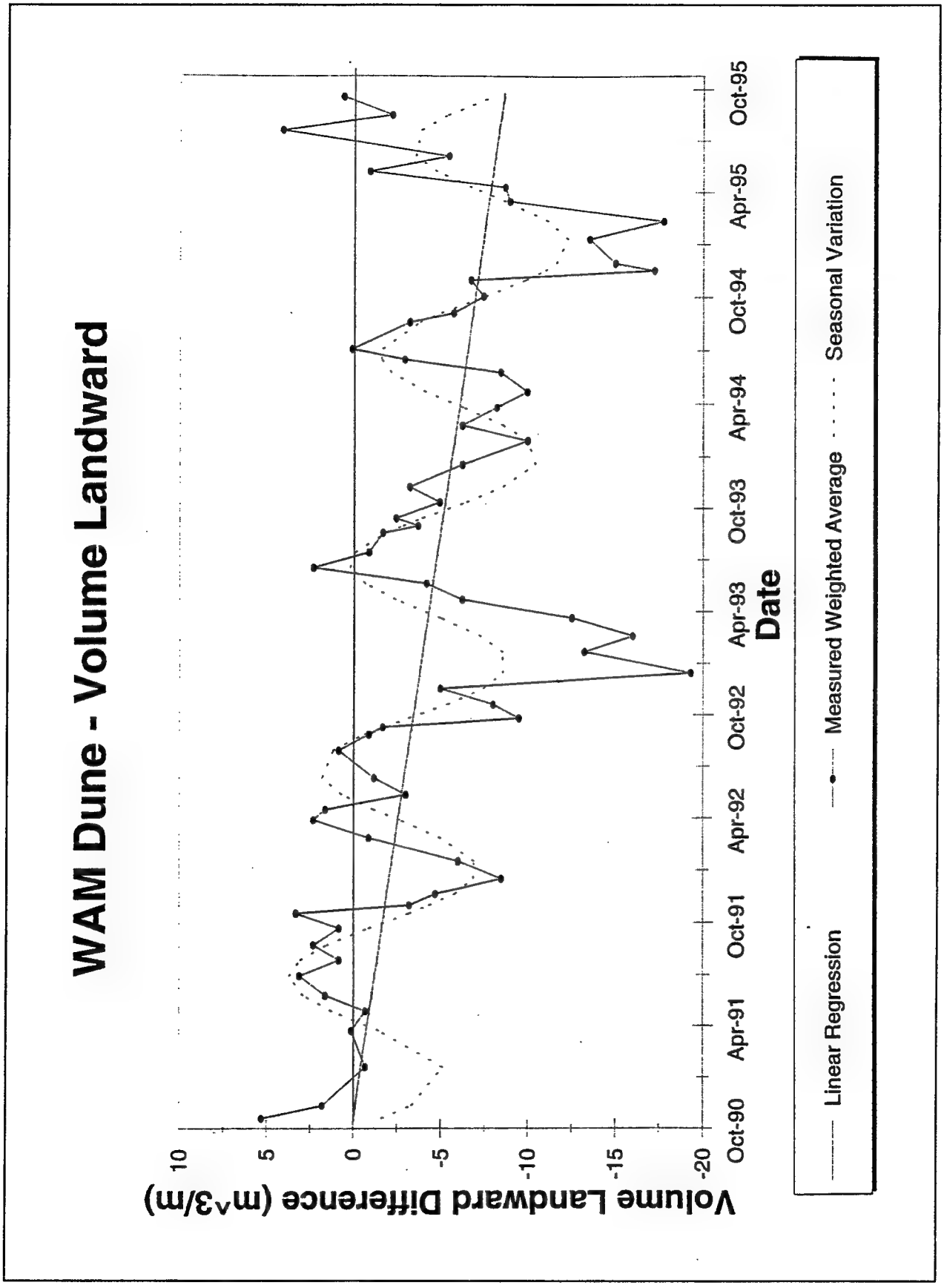
Appendix A
Weighted Average Method (WAM) Results

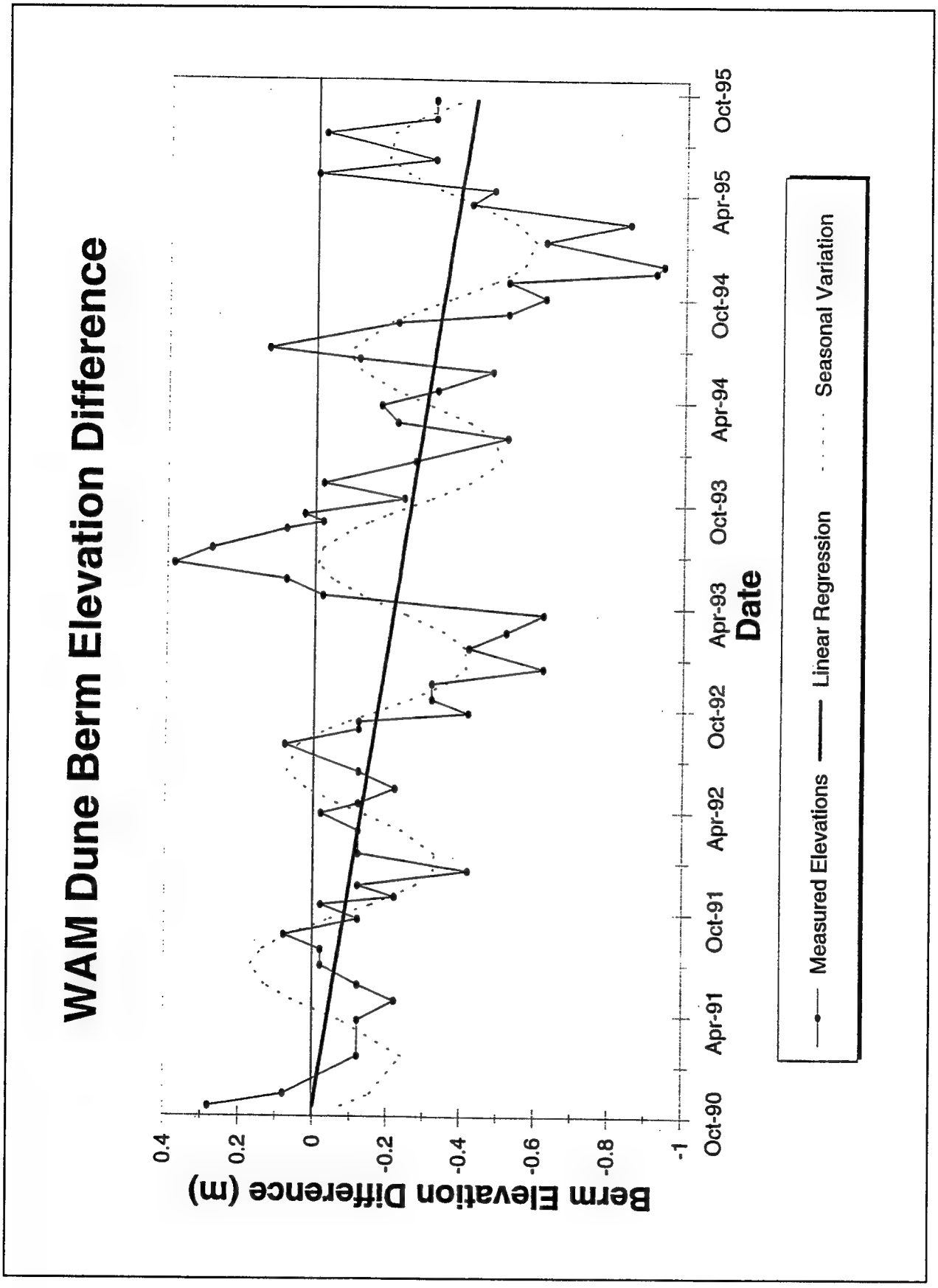
		Weighted Average Wall Parameter Values				
Survey Date	Survey Number	V(t) (m^3/m)	V(s) (m^3/m)	V(l) (m^3/m)	E(b) (m)	P (m)
10/20	3600	149.0	25.3	123.6	1.6	43.3
11/11	3610	150.2	18.8	131.4	1.5	41.1
01/19	3660	144.5	20.3	124.1	1.1	39.4
03/24	3700	154.7	23.1	131.7	1.9	42.6
04/28	3720	146.0	21.6	124.6	1.4	41.3
05/26	3740	146.7	22.3	124.4	1.4	42.0
06/30	3760	158.3	26.6	131.7	1.7	45.7
07/28	3780	157.5	25.3	132.4	1.7	44.0
08/23	3800	150.2	25.1	124.9	1.5	43.3
09/22	3820	138.9	14.5	124.4	0.9	36.2
10/18	3840	146.2	21.6	124.6	1.3	40.5
11/01	3851	140.9	16.8	124.4	1.0	37.0
11/22	3860	147.0	22.6	124.4	1.4	42.7
12/19	3880	136.2	12.3	124.1	0.6	34.3
01/18	3900	144.0	19.8	123.9	1.3	41.1
02/28	3920	143.7	19.8	123.9	1.3	41.0
03/30	3940	139.7	15.8	123.9	1.2	38.3
04/18	3960	138.7	15.0	123.6	1.0	36.1
05/15	3970	140.9	17.3	123.4	0.9	36.7
06/13	3990	144.0	19.8	124.1	1.3	39.0
07/31	4020	151.7	27.3	124.4	1.6	44.1
08/28	4042	147.7	23.6	124.4	1.5	41.4
09/11	4050	141.5	17.3	123.9	1.2	37.3
09/27	4060	131.7	9.3	122.1	0.3	33.6
10/22	4080	134.4	12.0	122.6	0.5	34.0
11/19	4090	136.4	13.8	122.6	1.0	35.6
12/16	4120	132.2	8.5	123.6	0.3	33.4
01/22	4140	137.9	14.5	123.4	0.5	35.7
02/19	4160	135.7	12.3	123.6	0.6	34.3
03/23	4180	133.9	11.0	122.9	0.8	33.9
04/25	4200	147.7	23.8	123.6	1.5	42.8
05/23	4220	147.2	23.3	123.9	1.6	42.2
06/20	4240	152.0	26.8	125.7	1.8	46.9
07/17	4260	159.3	28.8	130.4	2.1	48.4
08/21	4280	154.5	24.3	130.2	1.7	47.7
09/03	4290	151.0	20.8	129.9	1.6	45.8
09/16	4300	155.3	25.1	130.2	1.9	48.4
10/14	4320	143.5	13.8	129.7	1.4	41.7
11/10	4330	142.7	13.3	129.2	1.0	40.6
12/20	4360	148.5	18.6	129.9	1.6	44.2
01/31	4380	146.0	16.6	129.4	0.9	39.1
02/26	4400	151.0	21.1	129.9	1.2	46.1
03/29	4420	148.2	18.6	129.9	0.9	42.6
04/25	4440	151.3	21.1	129.9	1.2	44.0
05/29	4460	148.7	19.1	129.9	1.0	42.8
06/21	4480	154.8	25.6	129.2	1.5	47.9
07/09	4490	158.0	28.8	129.2	1.6	49.5
08/24	4520	154.0	24.8	129.4	1.3	46.0
09/08	4530	148.2	19.3	128.7	1.2	43.2
10/07	4550	147.0	17.8	128.9	0.8	42.4
11/04	4570	133.7	11.8	121.7	0.7	38.0
11/20	4580	130.4	4.8	125.7	0.1	35.3
12/02	4590	131.7	4.5	127.2	0.1	35.3
01/13	4610	141.7	14.3	127.2	0.8	39.9
02/13	4630	140.0	13.5	126.4	0.9	40.5
03/20	4660	142.5	15.8	126.7	0.7	42.6
04/14	4670	138.5	12.0	126.4	0.5	38.9
05/12	4690	139.2	12.8	126.7	0.8	40.0
06/09	4710	141.2	13.0	128.2	1.3	41.4
07/25	4740	142.2	14.0	128.2	1.2	40.5
08/21	4760	134.5	9.5	124.9	0.5	39.2
09/22	4780	136.5	10.8	125.7	0.7	39.7

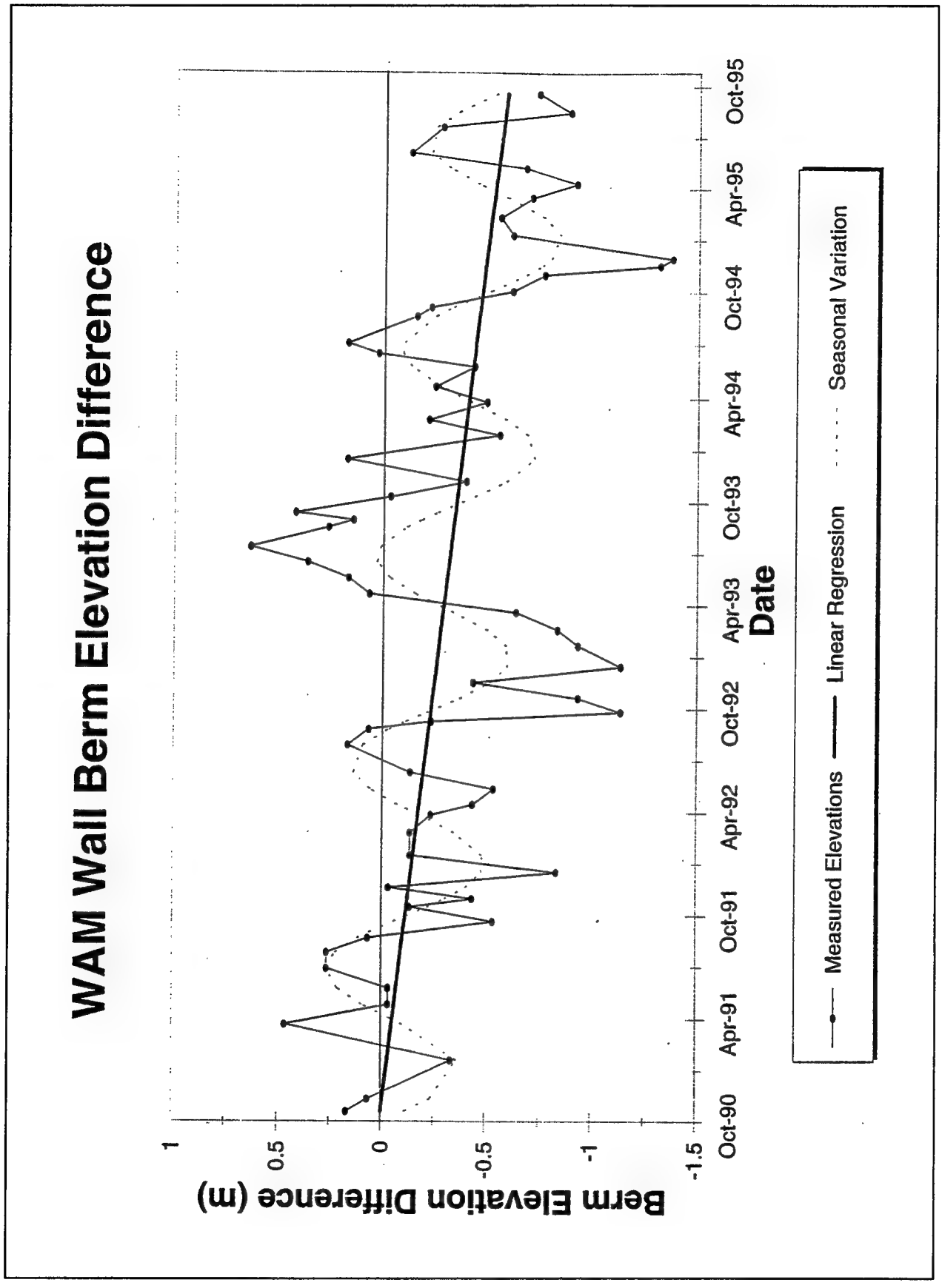
		Weighted Average Dune Parameter Values				
Survey Date	Survey Number	V(t) (m^3/m)	V(s) (m^3/m)	V(l) (m^3/m)	E(b) (m)	P (m)
10/20/90	3600	192.6	43.9	148.7	2.1	56.7
11/11/90	3610	181.3	36.1	145.2	1.9	53.3
1/19/91	3660	178.1	35.4	142.7	1.7	54.3
3/24/91	3700	176.3	32.9	143.5	1.7	51.3
4/28/91	3720	174.6	31.9	142.7	1.6	52.1
5/26/91	3740	180.6	35.6	145.0	1.7	54.7
6/30/91	3760	183.1	36.6	146.5	1.8	54.9
7/28/91	3780	179.1	34.9	144.2	1.8	51.9
8/23/91	3800	183.6	38.1	145.7	1.9	55.1
9/22/91	3820	178.6	34.6	144.2	1.7	51.1
10/18/91	3840	182.3	35.9	146.7	1.8	53.3
11/1/91	3851	171.3	30.8	140.2	1.6	50.3
11/22/91	3860	172.0	33.6	138.7	1.7	54.4
12/19/91	3880	158.5	23.6	134.9	1.4	44.4
1/18/92	3900	171.3	33.9	137.4	1.7	55.1
2/28/92	3920	175.3	32.6	142.5	1.7	54.4
3/30/92	3940	182.6	36.9	145.7	1.8	53.8
4/18/92	3960	179.8	34.6	145.0	1.7	51.2
5/15/92	3970	174.8	34.6	140.4	1.6	53.3
6/13/92	3990	179.1	36.9	142.2	1.7	52.8
7/31/92	4020	185.3	41.1	144.2	1.9	55.6
8/28/92	4042	180.8	38.4	142.5	1.7	53.7
9/11/92	4050	175.8	34.1	141.7	1.7	50.6
9/27/92	4060	163.5	29.6	133.9	1.4	47.2
10/22/92	4080	167.3	31.6	135.4	1.5	47.8
11/19/92	4090	168.3	29.8	138.4	1.5	48.8
12/16/92	4120	151.5	27.1	124.1	1.2	44.6
1/22/93	4140	161.3	31.1	130.2	1.4	46.3
2/19/93	4160	152.2	24.8	127.4	1.3	43.7
3/23/93	4180	153.5	22.6	130.9	1.2	43.3
4/25/93	4200	173.6	36.6	137.2	1.8	55.7
5/23/93	4220	173.1	33.9	139.2	1.9	52.4
6/20/93	4240	186.4	40.4	145.7	2.2	57.6
7/17/93	4260	180.1	37.9	142.5	2.1	55.9
8/21/93	4280	177.6	35.9	141.7	1.9	55.0
9/3/93	4290	178.3	38.6	139.7	1.8	57.5
9/16/93	4300	178.6	37.6	141.0	1.9	56.4
10/14/93	4320	165.8	27.3	138.5	1.6	51.4
11/10/93	4330	168.3	28.1	140.2	1.8	51.2
12/20/93	4360	170.6	33.4	137.2	1.6	57.1
1/31/94	4380	162.8	29.3	133.4	1.3	51.1
2/26/94	4400	171.3	34.1	137.2	1.6	55.4
3/29/94	4420	173.1	37.9	135.2	1.6	55.7
4/25/94	4440	165.6	32.1	133.4	1.5	53.2
5/29/94	4460	163.3	28.3	135.0	1.3	50.8
6/21/94	4480	172.3	31.9	140.5	1.7	54.1
7/9/94	4490	182.1	38.6	143.5	2.0	58.4
8/24/94	4520	170.6	30.4	140.2	1.6	53.0
9/8/94	4530	166.6	29.1	137.7	1.3	52.3
10/7/94	4550	163.3	27.3	136.0	1.2	49.2
11/4/94	4570	162.8	26.1	136.7	1.3	50.1
11/20/94	4580	148.5	22.3	126.2	0.9	45.1
12/2/94	4590	148.7	20.3	128.4	0.9	43.6
1/13/95	4610	155.3	25.3	129.9	1.2	47.7
2/13/95	4630	147.0	21.3	125.7	1.0	46.8
3/20/95	4660	164.8	30.4	134.5	1.4	51.3
4/14/95	4670	161.3	26.6	134.7	1.3	49.9
5/12/95	4690	169.8	27.1	142.5	1.8	49.8
6/9/95	4710	165.8	27.8	138.0	1.5	51.5
7/25/95	4740	183.1	35.6	147.5	1.8	54.9
8/21/95	4760	168.3	27.3	141.2	1.5	50.8
9/22/95	4780	174.3	30.4	144.0	1.5	50.8

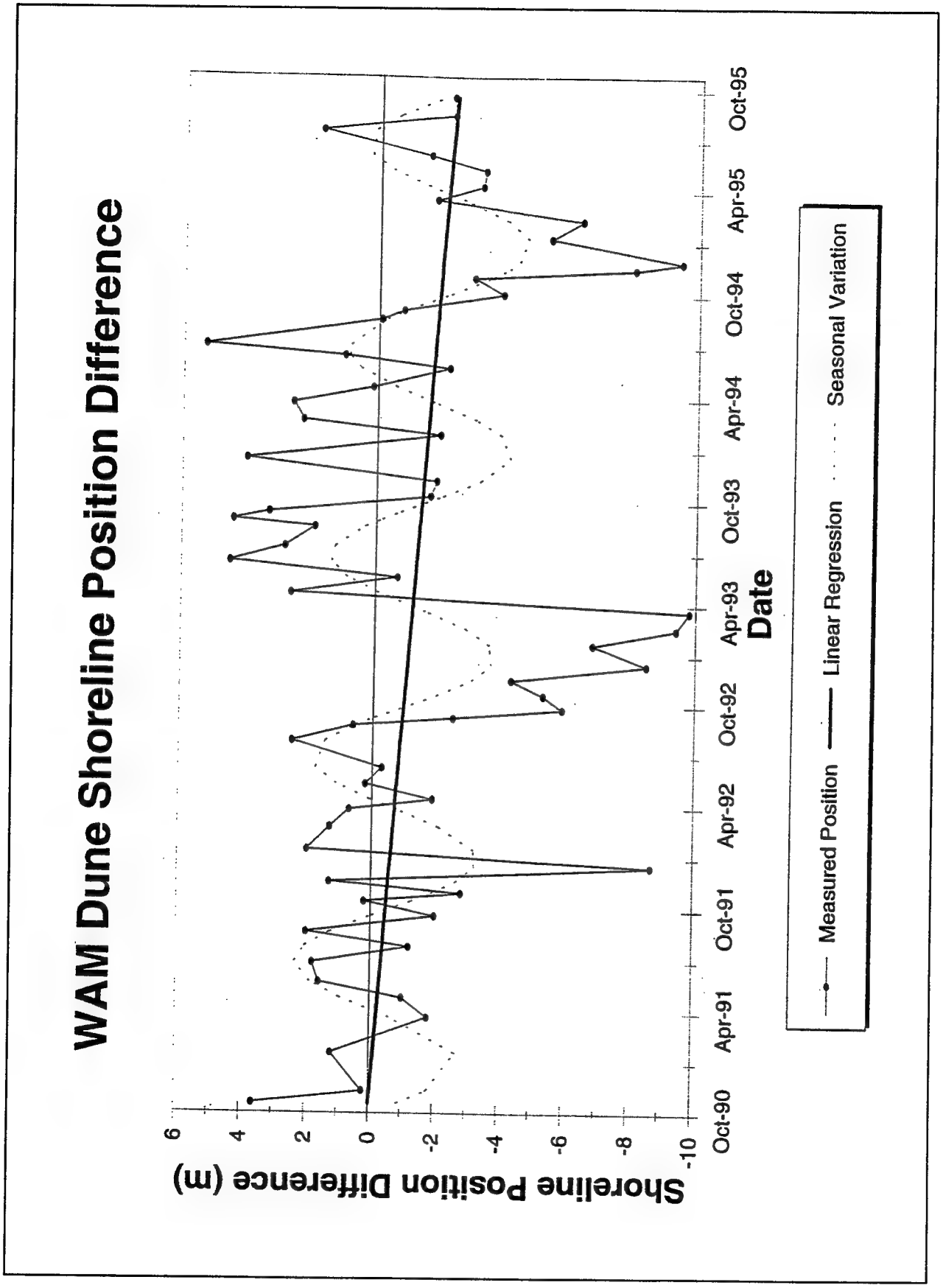

WAM Dune - Volume Seaward
Volume Seaward Difference (m^3/m)
10
5
0
-5
-10
-15
-20
Oct-90
Apr-91
Oct-91
Apr-92
Oct-92
Apr-93
Oct-93
Apr-94
Oct-94
Apr-95
Oct-95
Date
Linear Regression
Measured Weighted Average
Seasonal Variation

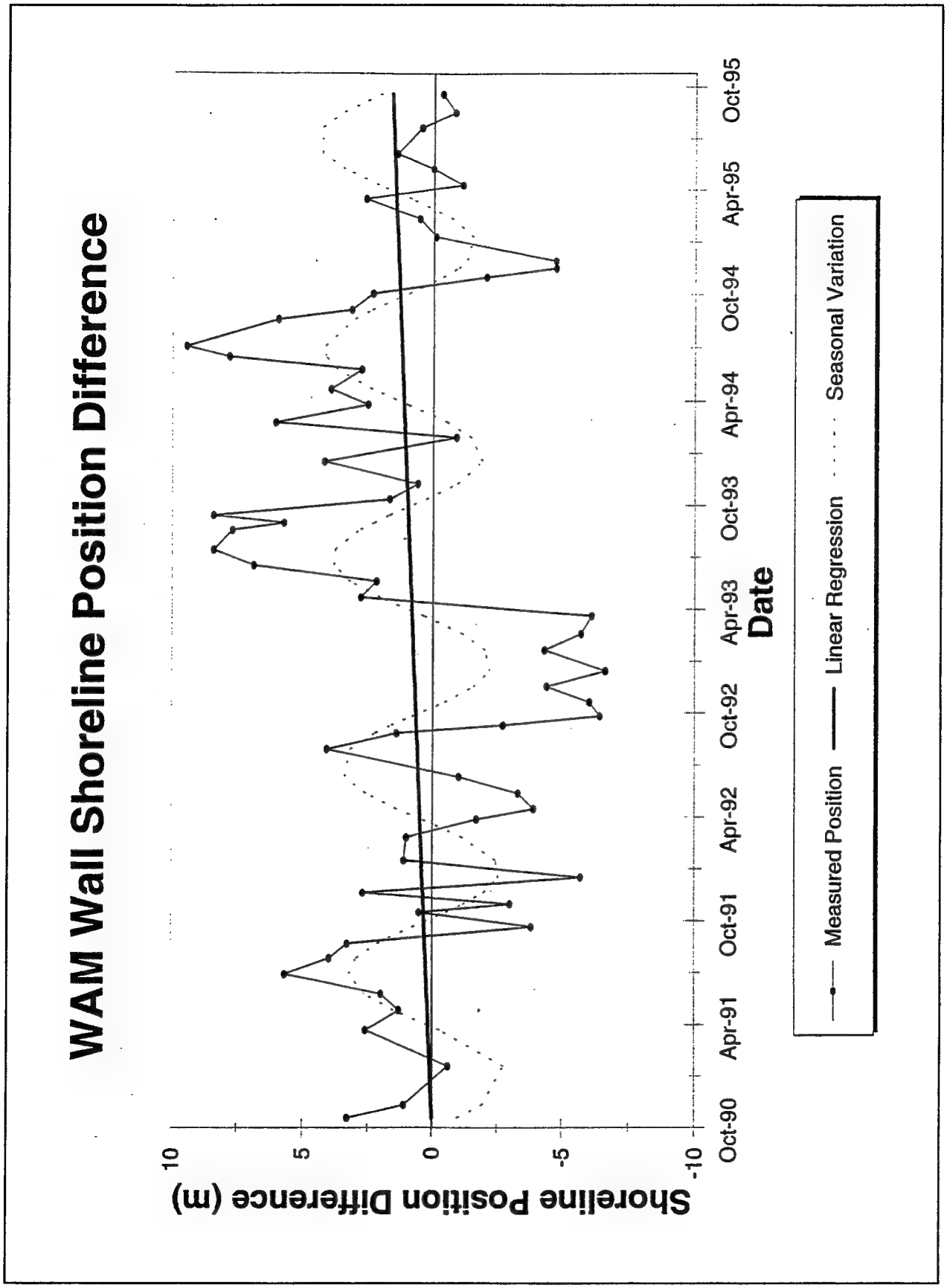

WAM Wall - Volume Seaward
Volume Seaward Difference (m^3/m)
10
5
0
-5
-10
-15
-20
Oct-90
Apr-91
Oct-91
Apr-92
Oct-92
Apr-93
Oct-93
Apr-94
Oct-94
Apr-95
Oct-95
Date
Linear Regression
Measured Weighted Average
Seasonal Variation


WAM Dune - Volume Landward
Volume Landward Difference (m^3/m)
10
5
0
-5
-10
-15
-20
Oct-90
Apr-91
Oct-91
Apr-92
Oct-92
Apr-93
Oct-93
Apr-94
Oct-94
Apr-95
Oct-95
Date
Linear Regression
Measured Weighted Average
Seasonal Variation


WAM Dune Berm Elevation Difference
Berm Elevation Difference (m)
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
Oct-90
Apr-91
Oct-91
Apr-92
Oct-92
Apr-93
Oct-93
Apr-94
Oct-94
Apr-95
Oct-95
Date
Measured Elevations
Linear Regression
Seasonal Variation


WAM Wall Berm Elevation Difference
Berm Elevation Difference (m)
1
0.5
0
-0.5
-1
-1.5
Oct-90
Apr-91
Oct-91
Apr-92
Oct-92
Apr-93
Oct-93
Apr-94
Oct-94
Apr-95
Oct-95
Date
Measured Elevations
Linear Regression
Seasonal Variation


WAM Dune Shoreline Position Difference
Shoreline Position Difference (m)
6
4
2
0
-2
-4
-6
-8
-10
Oct-90
Apr-91
Oct-91
Apr-92
Oct-92
Apr-93
Oct-93
Apr-94
Oct-94
Apr-95
Oct-95
Date
Measured Position
Linear Regression
Seasonal Variation


WAM Wall Shoreline Position Difference
Shoreline Position Difference (m)
10
5
0
-5
-10
Oct-90
Apr-91
Oct-91
Apr-92
Oct-92
Apr-93
Oct-93
Apr-94
Oct-94
Apr-95
Oct-95
Date
Measured Position
Linear Regression
Seasonal Variation

Appendix B
Sectional Weighted Average Method (WAMSECT) Results

WAMSECT Parameters for Dunes at Sandbridge, VA.

ODU SURVEY NUMBER	DATE	Days Since 1/1/1800	WEIGHTED AVERAGE NORTH END			WEIGHTED AVERAGE MIDDLE SECTION			WEIGHTED AVERAGE SOUTH END		
			Vt (m^3/m)	Vs (m^3/m)	Vl (m^3/m)	Vt (m^3/m)	Vs (m^3/m)	Vl (m^3/m)	Vt (m^3/m)	Vs (m^3/m)	Vl (m^3/m)
3600	10/18/90	69641	192.6	25.1	167.6	245.1	50.9	193.9	103.1	49.2	53.9
3610	11/07/90	69661	170.8	14.5	156.3	225.5	43.6	181.6	87.8	38.1	49.4
3660	01/19/91	69734	165.6	23.3	142.2	220.2	37.4	182.9	89.3	42.6	46.7
3680	02/15/91	69761	176.1	29.8	146.5	167.6	25.3	139.7	90.3	43.6	46.7
3700	03/24/91	69798	162.0	21.8	140.0	215.5	32.9	182.6	95.1	46.2	49.2
3720	04/27/91	69832	167.1	21.3	145.7	216.5	34.9	181.9	82.5	35.1	47.4
3740	05/25/91	69860	174.6	25.1	149.5	222.7	39.1	183.6	86.5	37.1	49.2
3760	06/29/91	69895	178.1	27.1	151.0	238.8	41.1	197.7	89.5	39.4	50.2
3780	07/27/91	69923	173.3	23.3	150.0	220.5	38.1	182.4	88.0	38.4	49.9
3800	08/22/91	69949	172.1	21.8	150.3	206.2	46.9	159.3	88.8	38.4	50.4
3820	09/19/91	69977	167.3	15.6	151.8	197.9	40.6	156.8	86.5	39.6	46.9
3840	10/15/91	70003	180.4	19.1	161.3	225.8	40.4	185.4	89.3	41.6	47.7
3851	10/29/91	70017	164.3	18.6	145.5	215.2	34.9	180.1	73.7	32.9	40.9
3860	11/17/91	70036	167.6	28.6	139.0	213.7	34.6	179.1	78.5	36.9	41.6
3880	12/15/91	70064	150.8	13.3	137.5	199.7	24.6	174.8	68.7	31.6	37.1
3900	01/17/92	70097	157.3	23.8	133.7	215.5	37.4	178.1	78.5	35.4	43.1
3920	02/27/92	70138	173.6	26.6	147.0	216.2	33.4	182.6	80.5	37.6	42.9
3940	03/28/92	70168	178.6	25.3	153.5	224.5	39.4	185.1	87.3	41.9	45.7
3960	04/15/92	70188	173.8	23.1	150.8	225.8	39.9	185.9	76.5	33.9	42.9
3970	05/14/92	70215	162.0	22.3	140.0	220.5	39.1	181.4	78.0	35.1	42.6
3990	06/10/92	70242	175.6	27.6	147.7	213.0	34.6	178.3	81.0	37.9	43.1
4020	07/28/92	70290	174.3	24.6	149.8	229.0	45.4	183.6	91.8	46.4	45.4
4042	08/25/92	70318	171.1	21.6	149.5	223.0	42.1	180.9	88.8	43.9	45.2
4050	09/07/92	70331	165.6	17.1	148.2	221.5	41.4	180.1	77.0	31.9	45.2
4060	09/23/92	70347	143.0	17.3	125.9	208.9	32.9	176.1	72.7	33.4	39.4
4080	10/19/92	70373	144.2	15.6	128.7	215.2	36.6	178.6	72.5	34.9	37.9
4090	11/08/92	70393	148.5	14.0	134.4	211.2	31.1	180.1	75.0	33.9	41.4
4120	12/13/92	70428	111.1	9.0	102.1	200.2	33.6	166.6	68.0	28.1	39.9
4140	01/21/93	70467	133.4	17.6	115.9	207.4	34.6	173.1	75.0	36.1	38.6
4160	02/17/93	70494	125.7	12.8	112.9	195.7	26.6	169.3	71.5	32.6	38.9
4180	03/20/93	70525	138.7	14.3	124.4	193.6	22.1	171.6	71.2	32.4	38.9
4200	04/22/93	70558	167.6	30.6	137.0	214.2	38.6	175.6	83.3	38.1	45.2
4220	05/20/93	70586	188.9	32.1	156.8	206.4	33.6	173.1	83.0	38.1	44.9
4240	06/16/93	70613	182.6	35.4	147.0	228.0	41.1	186.9	87.8	41.6	46.2
4260	07/14/93	70641	190.4	35.1	155.3	218.2	38.1	180.4	88.8	41.4	47.4
4280	08/17/93	70675	187.1	34.1	153.0	217.5	37.1	180.4	85.0	39.4	45.9
4290	08/30/93	70688	184.1	31.4	152.8	216.5	38.6	177.6	88.5	43.6	44.9
4300	09/13/93	70702	180.6	29.3	151.3	220.2	40.1	180.1	83.8	38.4	45.4
4320	10/11/93	70730	154.5	15.6	138.7	207.2	29.3	177.8	71.5	29.6	41.9
4330	11/07/93	70757	158.3	15.8	142.5	210.0	30.1	179.9	73.2	30.4	42.9
4360	12/17/93	70797	156.3	18.6	137.7	217.5	39.1	178.1	64.2	26.8	37.4
4380	01/28/94	70839	133.9	11.0	122.7	210.7	33.9	177.1	63.0	29.1	33.9
4400	02/23/94	70865	160.5	22.3	138.2	215.5	36.9	178.6	72.5	35.1	37.4
4420	03/26/94	70896	149.5	23.8	125.7	227.0	45.9	181.1	67.7	29.8	37.9
4440	04/22/94	70923	150.5	21.1	129.7	213.0	35.6	177.3	69.5	31.4	38.4
4460	05/26/94	70957	142.7	18.8	124.2	209.7	30.9	178.8	62.0	28.1	33.9
4480	06/18/94	70980	169.1	24.3	145.0	215.7	34.1	181.6	70.2	30.6	39.6
4490	07/06/94	70998	176.6	35.4	141.5	226.0	40.6	185.4	78.3	35.4	42.9
4520	08/21/94	71044	165.3	24.1	141.2	214.0	32.4	181.6	68.0	29.3	38.6
4530	09/05/94	71059	146.5	19.6	126.9	211.2	30.6	180.9	68.5	30.6	37.9
4550	10/07/94	71087	156.8	18.6	138.2	205.2	28.6	176.6	65.0	28.8	36.1
4570	11/04/94	71114	159.0	18.6	140.5	204.9	27.6	177.3	61.7	25.8	35.9
4580	11/20/94	71130	136.5	14.5	121.9	195.9	27.6	168.3	41.1	14.5	26.6
4590	12/02/94	71142	130.7	9.5	121.2	197.2	25.3	171.8	41.6	14.5	27.1
4610	01/13/95	71188	131.7	16.1	115.9	202.4	29.1	173.3	54.4	22.1	32.1
4630	02/13/95	71218	132.7	15.1	117.9	192.9	26.1	166.8	44.4	13.8	30.6
4660	03/20/95	71255	135.7	16.1	119.4	215.0	35.6	179.3	59.2	25.8	33.4
4670	04/14/95	71279	117.9	9.8	108.1	214.0	32.9	181.4	54.9	20.3	34.6
4690	05/12/95	71307	132.4	9.3	123.2	221.7	32.4	189.4	61.5	23.8	37.6
4710	06/09/95	71334	133.4	14.0	119.4	213.7	32.4	181.4	67.5	24.8	42.6
4740	07/25/95	71380	174.6	31.1	143.2	228.5	38.4	190.4	79.5	32.9	46.7
4760	08/21/95	71406	153.0	13.0	139.7	217.2	32.9	184.4	66.7	26.6	40.1
4780	09/22/95	71437	167.6	18.1	149.2	224.2	37.6	186.6	59.4	20.8	38.6

WAMSECT Parameters for Dunes at Sandbridge, VA.

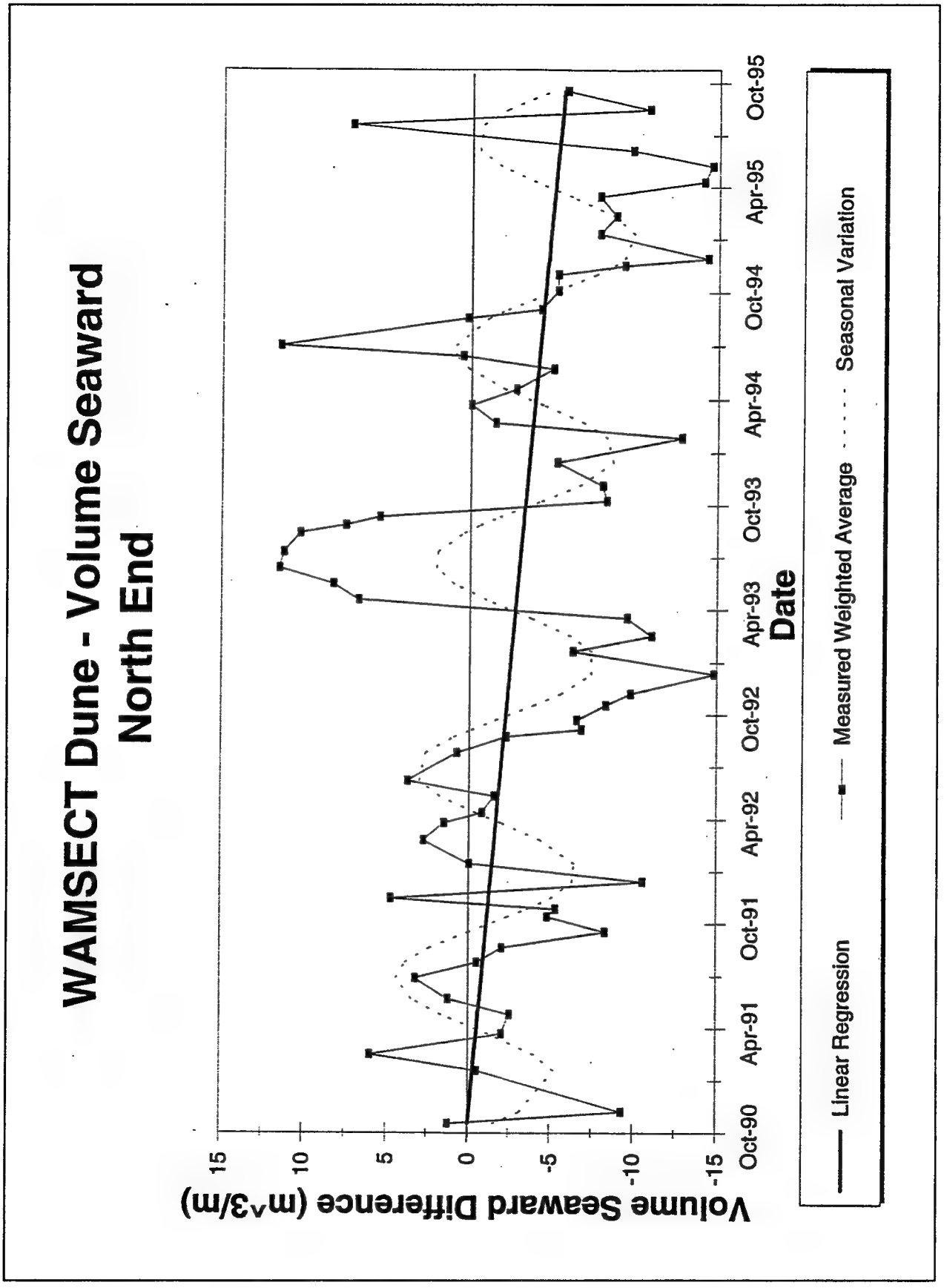
ODU SURVEY NUMBER	DATE	Days Since 1/1/1800	WAMSECT PARAMETERS					
			NORTH END		MIDDLE SECTION		SOUTH END	
			P (m)	Eb (m)	P (m)	Eb (m)	P (m)	Eb (m)
3600	10/18/90	69641	61.6	1.7	70.3	2.2	39.5	2.5
3610	11/07/90	69661	54.8	1.1	65.5	2.0	34.5	2.4
3660	01/19/91	69734	62.1	0.9	65.1	1.6	38.9	2.3
3680	02/15/91	69761	64.7	1.4	72.3	2.0	38.4	2.1
3700	03/24/91	69798	58.8	1.2	60.3	1.7	38.8	2.3
3720	04/27/91	69832	56.3	1.1	63.1	1.5	33.6	2.2
3740	05/25/91	69860	61.0	1.3	66.6	1.7	34.8	2.0
3760	06/29/91	69895	61.3	1.5	67.6	1.8	36.1	2.1
3780	07/27/91	69923	58.2	1.6	63.4	1.8	32.6	2.2
3800	08/22/91	69949	60.0	1.3	66.1	2.0	35.5	2.2
3820	09/19/91	69977	54.7	1.0	64.2	1.7	33.4	2.0
3840	10/15/91	70003	58.4	1.4	66.3	1.9	38.0	2.0
3851	10/29/91	70017	58.5	1.2	64.1	1.6	33.6	1.8
3860	11/17/91	70036	64.0	1.5	63.9	1.6	35.5	2.0
3880	12/15/91	70064	52.7	0.9	56.6	1.4	27.7	1.7
3900	01/17/92	70097	61.4	1.4	66.1	1.7	35.1	1.9
3920	02/27/92	70138	65.0	1.2	64.0	1.7	36.0	2.0
3940	03/28/92	70168	62.9	1.4	66.3	1.8	36.1	2.2
3960	04/15/92	70186	59.3	1.2	64.6	1.8	31.3	2.0
3970	05/14/92	70215	61.0	1.0	65.4	1.6	34.5	1.8
3990	06/10/92	70242	61.7	1.4	60.1	1.6	32.4	1.8
4020	07/28/92	70290	59.5	1.4	66.6	1.9	37.3	2.1
4042	08/25/92	70318	58.8	1.3	65.2	1.7	35.5	2.0
4050	09/07/92	70331	54.6	1.0	64.0	1.7	30.7	2.1
4060	09/23/92	70347	53.3	0.6	62.0	1.5	30.1	1.7
4080	10/19/92	70373	49.5	0.5	61.8	1.7	29.6	1.7
4090	11/08/92	70393	53.7	0.8	60.1	1.6	33.2	1.8
4120	12/13/92	70428	37.6	0.2	61.4	1.2	29.3	1.6
4140	01/21/93	70467	50.0	0.6	59.4	1.5	32.5	1.8
4160	02/17/93	70494	48.9	0.6	55.1	1.5	29.6	1.5
4180	03/20/93	70525	49.8	0.7	53.3	1.3	33.4	1.6
4200	04/22/93	70558	66.8	1.4	64.7	1.8	37.0	2.2
4220	05/20/93	70586	65.0	1.7	60.9	1.9	34.6	2.0
4240	06/16/93	70613	66.7	1.7	64.0	2.3	37.0	2.1
4260	07/14/93	70641	65.3	1.9	62.4	2.2	35.8	2.2
4280	08/17/93	70675	66.1	1.6	61.4	2.0	35.1	2.1
4290	08/30/93	70688	65.7	1.3	64.0	1.9	36.5	2.0
4300	09/13/93	70702	64.8	1.4	64.0	2.0	34.5	1.9
4320	10/11/93	70730	56.5	0.9	59.1	1.7	29.7	1.6
4330	11/07/93	70757	54.2	1.0	59.2	2.0	29.9	1.7
4360	12/17/93	70797	58.1	1.3	68.0	1.7	29.5	1.4
4380	01/28/94	70839	48.2	0.5	61.9	1.5	26.4	1.3
4400	02/23/94	70865	59.2	0.8	63.5	1.6	34.0	1.8
4420	03/26/94	70896	64.2	0.8	66.6	1.9	30.3	1.5
4440	04/22/94	70923	58.8	1.0	63.0	1.6	30.6	1.7
4460	05/26/94	70957	51.0	0.5	59.8	1.6	28.6	1.3
4480	06/18/94	70980	60.3	1.2	61.9	1.9	31.4	1.6
4490	07/06/94	70998	67.0	1.5	66.0	2.0	34.9	2.0
4520	08/21/94	71044	59.1	1.2	61.3	1.7	29.3	1.5
4530	09/05/94	71059	52.9	0.5	60.3	1.4	32.2	1.5
4550	10/07/94	71087	56.0	1.0	57.2	1.2	25.4	1.3
4570	11/04/94	71114	57.0	1.2	58.6	1.3	25.0	1.4
4580	11/20/94	71130	50.0	0.7	56.1	1.1	15.7	0.6
4590	12/02/94	71142	50.2	0.6	53.3	1.1	16.4	0.5
4610	01/13/95	71188	51.1	0.6	57.5	1.4	21.9	1.2
4630	02/13/95	71218	52.5	0.6	56.3	1.2	20.3	0.7
4660	03/20/95	71255	51.6	0.6	62.1	1.7	24.7	1.1
4670	04/14/95	71279	46.5	0.5	61.2	1.6	23.3	1.1
4690	05/12/95	71307	48.5	0.6	59.8	2.3	24.7	1.3
4710	06/09/95	71334	52.5	0.8	60.9	1.7	28.3	1.5
4740	07/25/95	71380	63.3	1.6	63.0	2.0	30.6	1.6
4760	08/21/95	71406	54.4	1.0	60.8	1.8	27.1	1.4
4780	09/22/95	71437	57.0	1.5	61.0	1.8	23.3	1.0

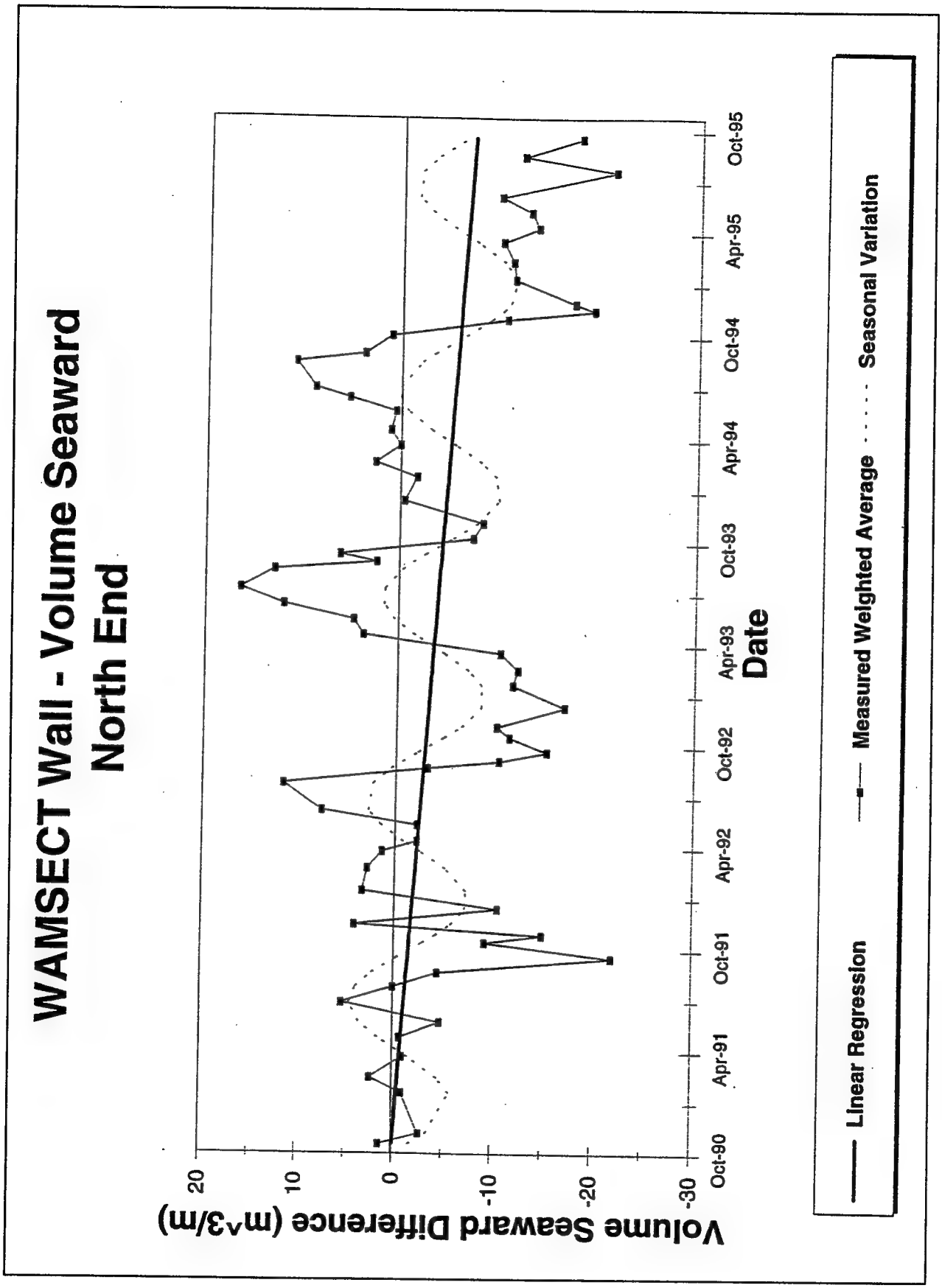
WAMSECT Parameters for Walls at Sandbridge, VA.

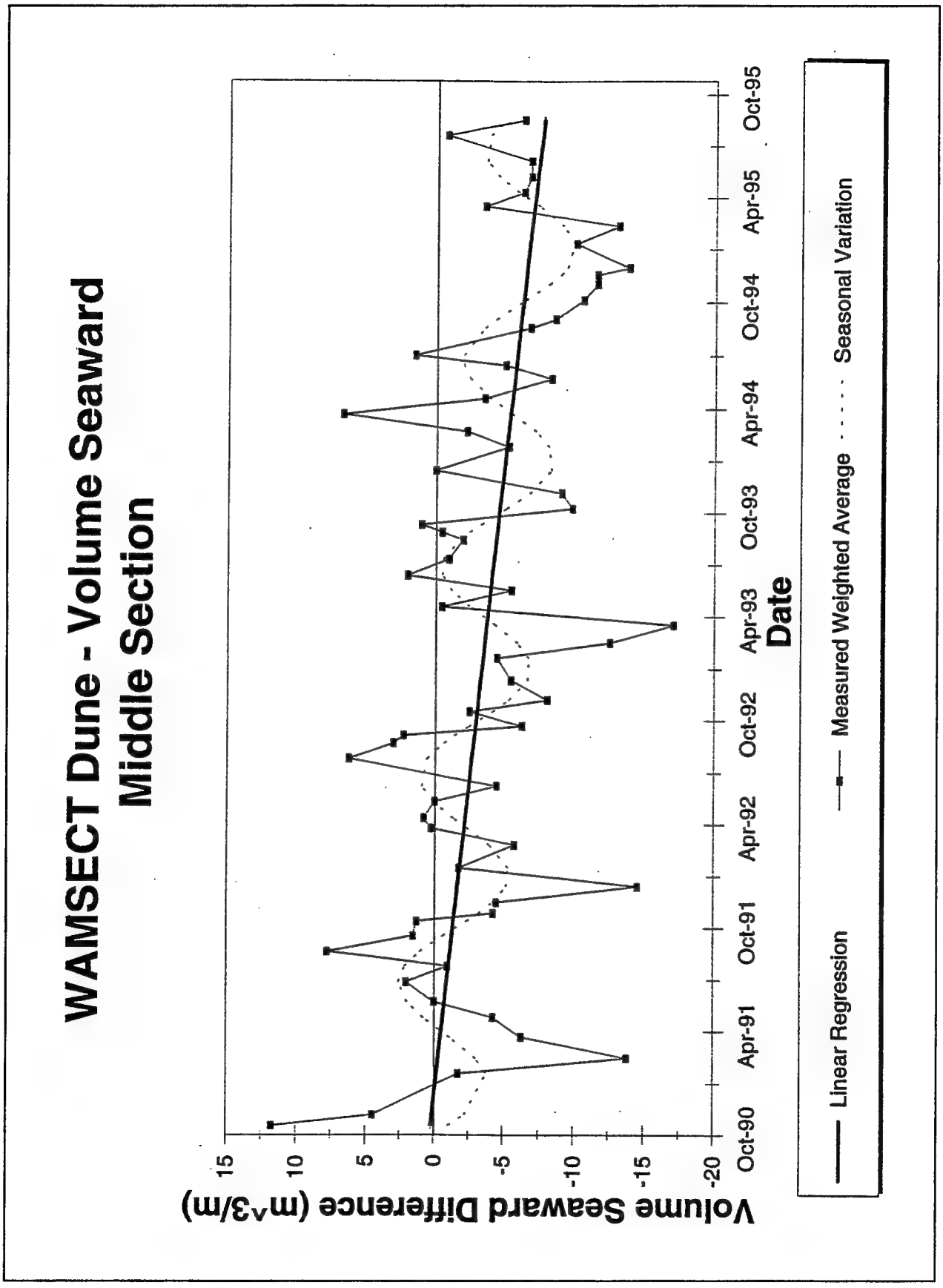
ODU SURVEY NUMBER	DATE	Days Since 1/1/1800	WEIGHTED AVERAGE NORTH END			WEIGHTED AVERAGE MIDDLE SECTION			WEIGHTED AVERAGE SOUTH END		
			Vt (m^3/m)	Vs (m^3/m)	Vl (m^3/m)	Vt (m^3/m)	Vs (m^3/m)	Vl (m^3/m)	Vt (m^3/m)	Vs (m^3/m)	Vl (m^3/m)
3600	10/18/90	69641	221.2	26.3	194.9	208.7	32.9	175.8	89.5	25.8	63.5
3610	11/07/90	69661	217.7	22.3	195.4	187.1	19.3	167.8	82.3	17.3	65.0
3660	01/19/91	69734	219.2	24.1	195.2	197.2	22.6	174.8	85.8	20.8	65.0
3680	02/15/91	69761	222.7	27.3	195.4	200.7	24.8	175.8	83.5	20.1	64.0
3700	03/24/91	69798	219.2	24.1	195.2	201.9	25.8	175.8	86.5	21.6	65.0
3720	04/27/91	69832	220.5	24.3	196.2	202.9	27.6	175.6	84.0	19.1	65.2
3740	05/25/91	69860	216.0	20.3	195.9	203.7	28.3	175.1	87.8	22.8	65.0
3760	06/29/91	69895	226.5	30.4	196.2	199.2	30.9	168.6	89.0	24.3	65.0
3780	07/27/91	69923	222.5	25.1	197.7	207.4	31.9	175.6	82.5	17.8	65.0
3800	08/22/91	69949	217.5	20.6	196.9	214.0	38.4	175.6	88.3	22.3	65.7
3820	09/19/91	69977	200.2	3.0	196.9	198.4	23.1	175.3	84.8	20.1	64.7
3840	10/15/91	70003	214.0	15.8	197.9	206.9	31.9	175.1	87.5	22.6	64.7
3851	10/29/91	70017	129.4	10.0	119.6	198.2	23.1	175.1	77.5	14.3	63.5
3860	11/17/91	70036	225.8	29.1	196.4	206.2	30.9	175.3	80.5	17.1	63.5
3880	12/15/91	70064	210.5	14.5	195.9	193.4	18.8	174.8	72.0	8.5	63.5
3900	01/17/92	70097	225.0	28.3	196.7	197.7	22.6	174.8	80.8	17.6	63.2
3920	02/27/92	70138	224.8	27.8	196.7	201.4	26.6	175.1	77.0	13.8	63.2
3940	03/28/92	70168	223.2	26.3	197.2	187.6	13.0	174.6	77.5	14.3	63.2
3960	04/15/92	70186	219.5	22.8	196.9	190.4	16.3	174.3	77.8	14.5	63.2
3970	05/14/92	70215	219.2	22.8	196.2	193.9	19.3	174.3	83.5	18.9	64.7
3990	06/10/92	70242	229.5	32.6	196.9	197.9	22.3	175.6	78.3	15.1	63.2
4020	07/28/92	70290	233.8	36.6	197.2	213.2	36.4	176.6	82.8	19.3	63.2
4042	08/25/92	70318	218.5	21.8	196.7	216.2	39.9	176.6	75.8	13.3	62.5
4050	09/07/92	70331	210.2	14.5	195.9	207.7	31.9	175.8	75.0	11.8	63.2
4060	09/23/92	70347	204.2	9.8	194.1	182.4	9.8	172.8	73.5	11.5	62.0
4080	10/19/92	70373	208.4	13.5	194.7	187.1	13.5	173.6	74.7	12.5	62.0
4090	11/08/92	70393	210.0	14.8	194.9	191.1	17.3	173.8	75.0	13.0	62.0
4120	12/13/92	70428	204.9	8.0	196.9	182.9	8.8	174.1	72.7	11.5	61.5
4140	01/21/93	70467	210.5	13.3	197.2	191.4	17.3	174.1	77.5	16.1	61.5
4160	02/17/93	70494	196.4	12.8	183.6	190.9	16.6	174.3	70.5	9.3	61.5
4180	03/20/93	70525	211.7	14.5	197.2	186.4	12.3	174.1	71.0	9.5	61.2
4200	04/22/93	70558	226.5	28.6	197.9	210.7	34.9	175.8	78.3	17.1	61.2
4220	05/20/93	70586	228.0	29.6	198.4	208.4	32.6	175.8	77.8	16.6	61.2
4240	06/16/93	70613	235.3	36.9	198.4	213.2	37.1	176.1	78.0	16.8	61.2
4260	07/14/93	70641	239.6	41.4	197.9	214.7	38.9	175.8	73.5	13.0	60.5
4280	08/17/93	70675	236.8	37.9	198.9	198.4	24.1	174.3	75.0	14.5	60.5
4290	08/30/93	70688	224.5	27.3	197.2	199.9	24.8	175.1	73.5	13.0	60.5
4300	09/13/93	70702	228.5	31.1	197.7	203.9	28.6	175.3	78.8	18.3	60.5
4320	10/11/93	70730	206.2	17.6	188.6	192.4	17.8	174.6	69.5	8.8	60.5
4330	11/07/93	70757	204.7	16.6	188.1	191.6	17.1	174.6	69.7	9.0	60.7
4360	12/17/93	70797	213.7	24.6	189.1	198.7	23.6	175.1	70.5	10.0	60.5
4380	01/28/94	70839	211.7	23.3	188.4	195.4	21.3	174.1	70.2	9.8	60.5
4400	02/23/94	70865	216.7	27.6	189.1	203.2	28.8	174.3	74.0	12.3	61.7
4420	03/26/94	70896	214.0	25.1	189.1	197.4	23.6	173.8	72.7	11.0	61.7
4440	04/22/94	70923	215.2	26.1	189.4	206.2	31.9	174.3	72.2	10.5	61.7
4460	05/26/94	70957	215.0	25.6	189.4	198.4	24.6	173.8	72.5	10.8	61.7
4480	06/18/94	70980	213.5	30.4	183.1	217.0	41.6	175.3	72.7	11.5	61.2
4490	07/06/94	70998	217.0	33.9	183.1	223.7	48.4	175.3	73.5	12.3	61.2
4520	08/21/94	71044	219.7	35.9	183.9	213.2	37.6	175.6	71.0	10.0	61.2
4530	09/05/94	71059	211.2	28.8	182.4	199.7	25.1	174.6	73.2	12.0	61.2
4550	10/07/94	71087	208.7	26.1	182.6	200.4	26.1	174.3	69.2	7.3	62.0
4570	11/04/94	71114	198.2	14.3	183.9	199.4	24.6	174.8	64.5	3.5	60.5
4580	11/20/94	71130	185.1	5.5	179.6	183.4	9.5	173.8	57.2	1.3	56.2
4590	12/02/94	71142	186.6	7.5	179.1	183.4	9.5	173.8	60.2	0.5	59.7
4610	01/13/95	71188	194.9	13.5	181.4	196.7	22.8	174.1	67.5	9.0	58.4
4630	02/13/95	71218	196.9	13.8	183.1	193.6	20.6	173.1	64.0	7.3	56.7
4660	03/20/95	71255	198.2	14.8	183.4	196.7	23.8	172.8	68.7	11.5	56.9
4670	04/14/95	71279	194.7	11.3	183.4	195.2	22.3	172.8	62.5	5.8	56.7
4690	05/12/95	71307	195.2	12.0	183.1	196.9	23.6	173.3	62.0	5.0	56.9
4710	06/09/95	71334	200.7	15.1	185.6	197.9	22.6	175.3	61.5	4.3	57.4
4740	07/25/95	71380	185.6	3.5	182.1	192.4	17.3	175.1	77.0	18.1	58.9
4760	08/21/95	71406	192.4	12.8	179.6	186.1	13.5	172.3	61.0	5.0	55.9
4780	09/22/95	71437	187.6	7.0	180.6	199.9	26.3	173.6	60.2	3.3	56.9

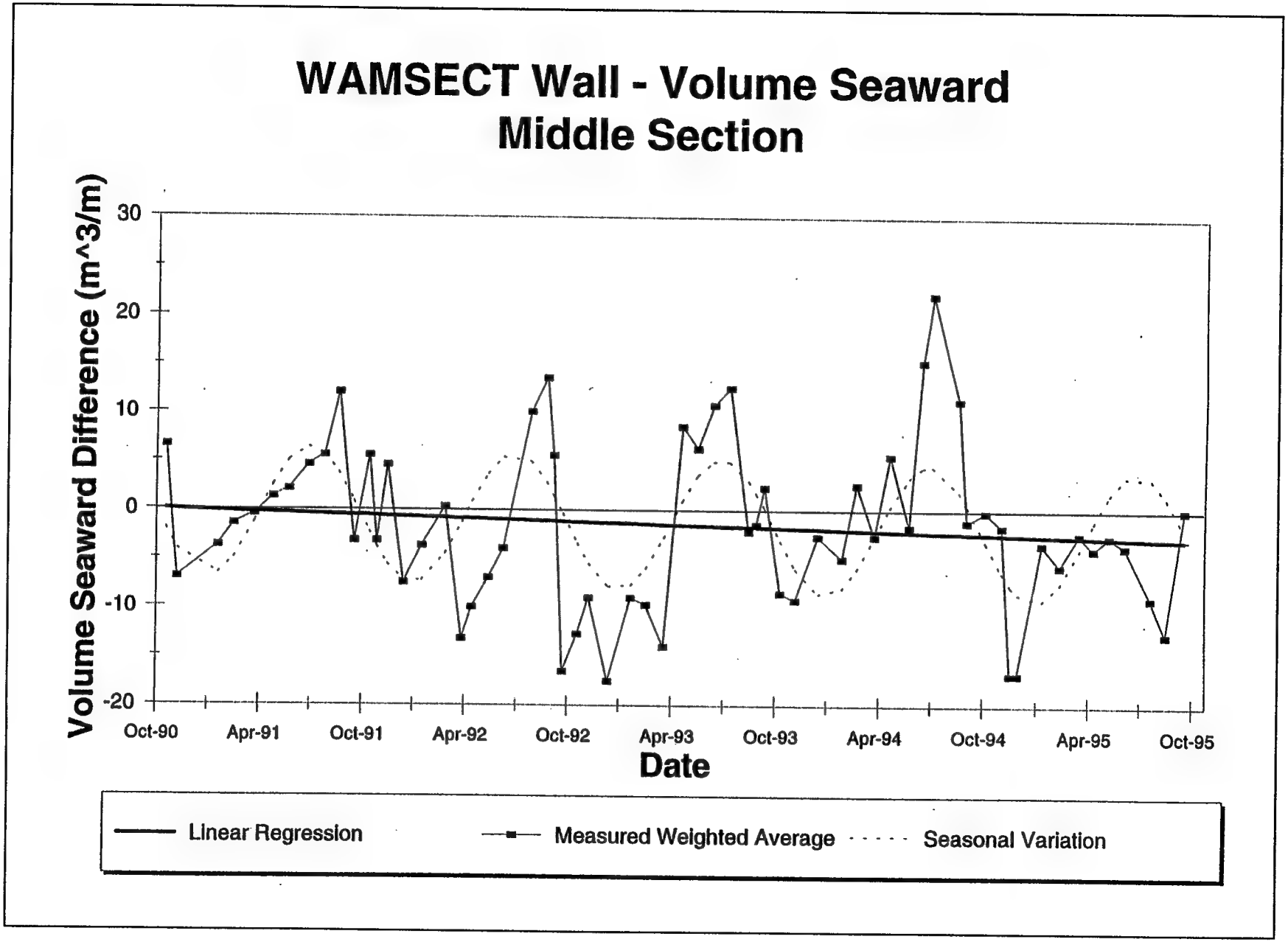
WAMSECT Parameters for Walls at Sandbridge, VA.

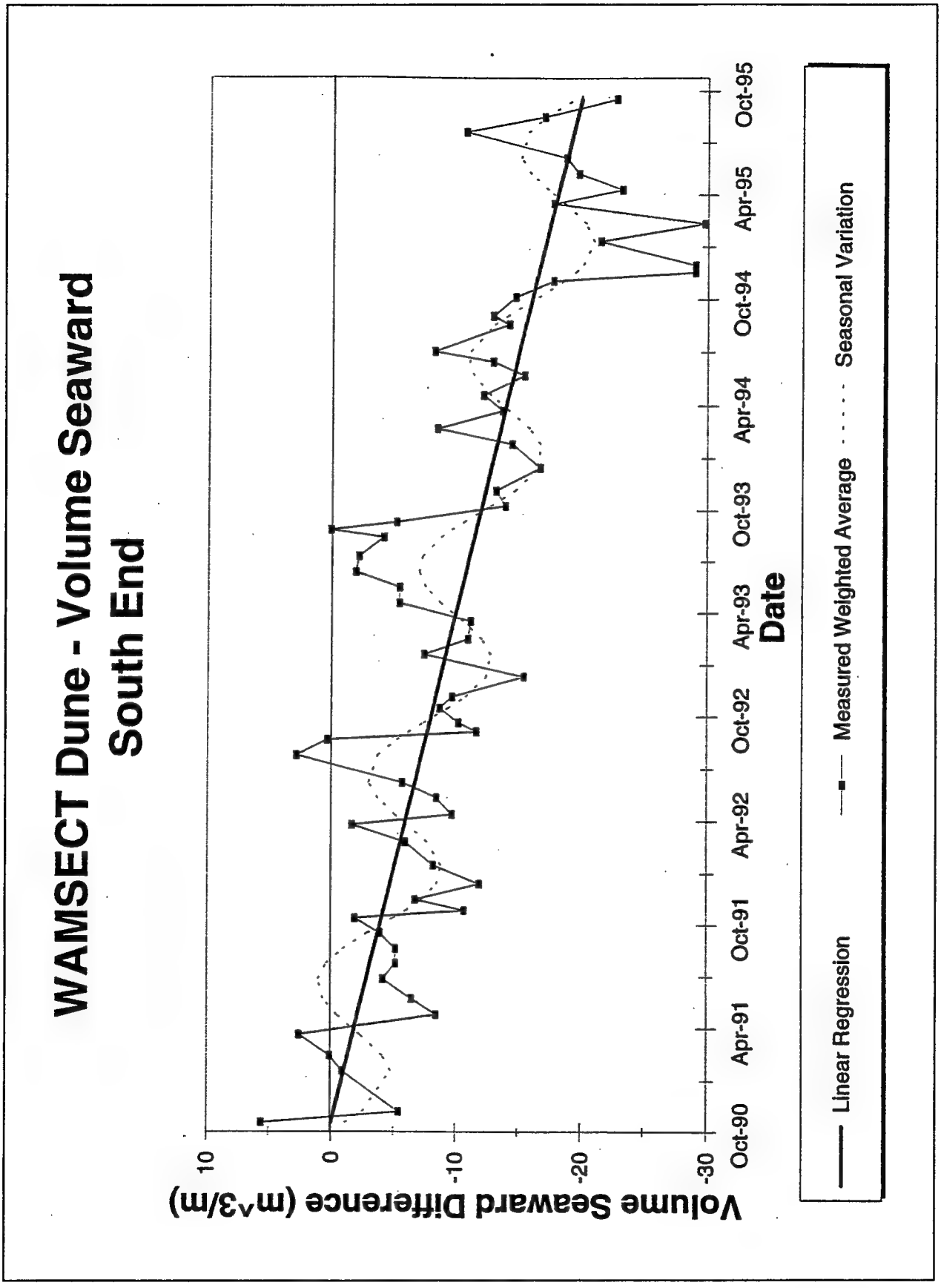
ODU SURVEY NUMBER	DATE	Days Since 1/1/1800	WAMSECT PARAMETERS					
			NORTH END		MIDDLE SECTION		SOUTH END	
			P (m)	Eb (m)	P (m)	Eb (m)	P (m)	Eb (m)
3600	10/18/90	69641	62.1	1.7	63.3	1.9	32.7	2.0
3610	11/07/90	69661	60.7	1.7	52.7	0.9	26.8	1.7
3660	01/19/91	69734	62.2	1.2	59.6	2.1	30.0	1.8
3680	02/15/91	69761	61.8	1.9	58.4	1.9	27.3	2.6
3700	03/24/91	69798	56.8	1.6	59.2	2.2	28.0	2.3
3720	04/27/91	69832	61.1	1.6	61.5	1.9	27.9	2.0
3740	05/25/91	69860	58.1	1.4	62.5	1.7	30.6	1.8
3760	06/29/91	69895	63.7	1.6	43.7	1.5	30.3	2.1
3780	07/27/91	69923	59.2	2.0	62.5	2.1	27.1	1.2
3800	08/22/91	69949	59.0	1.4	66.8	2.2	29.4	1.6
3820	09/19/91	69977	47.7	0.5	56.7	1.7	28.0	1.2
3840	10/15/91	70003	56.0	1.4	64.3	1.9	31.1	1.3
3851	10/29/91	70017	32.0	0.8	58.9	1.5	25.4	1.3
3860	11/17/91	70036	64.3	1.7	63.6	1.9	27.6	1.7
3880	12/15/91	70064	53.3	0.8	55.0	1.4	19.0	0.4
3900	01/17/92	70097	63.6	1.6	59.0	1.6	27.5	1.4
3920	02/27/92	70138	64.4	1.6	61.8	1.8	25.8	1.2
3940	03/28/92	70168	62.4	1.8	53.3	1.4	25.5	1.2
3960	04/15/92	70186	58.8	1.6	52.2	1.3	24.0	0.9
3970	05/14/92	70215	61.7	1.2	50.8	0.5	27.5	1.5
3990	06/10/92	70242	64.5	1.9	56.0	1.4	25.0	1.4
4020	07/28/92	70290	65.8	2.0	65.6	2.0	28.0	1.6
4042	08/25/92	70318	59.3	1.4	66.4	2.1	24.3	1.3
4050	09/07/92	70331	53.8	1.0	61.2	1.9	22.6	1.0
4060	09/23/92	70347	47.9	0.1	48.5	-0.5	23.9	1.1
4080	10/19/92	70373	51.7	0.6	49.2	0.3	22.1	0.7
4090	11/08/92	70393	54.3	1.1	53.9	1.2	22.7	0.9
4120	12/13/92	70428	49.2	0.4	49.2	-0.5	23.2	1.0
4140	01/21/93	70467	51.0	0.5	54.4	0.5	25.2	0.5
4160	02/17/93	70494	53.2	0.9	52.6	0.9	20.3	-0.1
4180	03/20/93	70525	52.8	1.5	50.9	1.7	21.9	0.7
4200	04/22/93	70558	64.3	1.7	65.5	1.8	27.1	1.6
4220	05/20/93	70586	63.6	2.0	63.4	2.0	26.5	1.5
4240	06/16/93	70613	66.8	2.2	65.5	2.2	26.8	1.5
4260	07/14/93	70641	66.9	2.2	65.0	2.9	24.5	1.4
4280	08/17/93	70675	68.3	2.3	58.5	1.7	26.1	1.3
4290	08/30/93	70688	62.1	1.4	59.6	2.1	24.5	1.4
4300	09/13/93	70702	64.8	1.7	61.8	2.6	27.9	1.4
4320	10/11/93	70730	57.5	1.2	54.1	2.2	22.9	1.0
4330	11/07/93	70757	55.6	1.1	53.6	1.1	22.0	0.9
4360	12/17/93	70797	61.8	1.6	58.8	2.3	22.3	1.0
4380	01/28/94	70839	58.2	1.0	52.0	2.0	18.6	0.1
4400	02/23/94	70865	63.9	1.4	62.5	1.5	23.7	0.9
4420	03/26/94	70896	61.1	1.4	57.1	1.3	20.6	0.4
4440	04/22/94	70923	61.2	1.3	62.9	2.1	19.5	0.5
4460	05/26/94	70957	61.8	1.3	55.9	1.2	21.2	0.7
4480	06/18/94	70980	64.0	1.9	67.8	1.6	23.6	1.1
4490	07/06/94	70998	65.5	1.9	71.8	1.7	23.8	1.3
4520	08/21/94	71044	66.0	1.9	65.7	2.0	19.8	0.5
4530	09/05/94	71059	64.6	1.3	54.2	1.2	24.3	1.2
4550	10/07/94	71087	60.8	1.4	59.6	1.4	18.8	0.0
4570	11/04/94	71114	54.7	1.3	58.4	1.8	18.4	-0.6
4580	11/20/94	71130	47.3	0.3	49.3	0.7	17.6	-0.5
4590	12/02/94	71142	49.4	0.4	48.7	0.7	17.5	-0.6
4610	01/13/95	71188	53.5	0.9	56.4	1.1	19.4	0.6
4630	02/13/95	71218	54.3	0.9	56.6	1.3	19.7	0.5
4660	03/20/95	71255	53.7	0.9	57.6	1.2	25.2	0.2
4670	04/14/95	71279	50.7	0.7	56.1	1.3	19.5	-0.1
4690	05/12/95	71307	52.8	1.1	57.4	1.5	19.5	0.0
4710	06/09/95	71334	56.3	2.2	57.9	1.6	19.6	0.4
4740	07/25/95	71380	46.9	0.3	57.5	1.2	23.4	1.6
4760	08/21/95	71406	54.4	1.1	52.6	0.8	19.9	0.0
4780	09/22/95	71437	50.5	0.7	60.1	1.9	19.2	0.0

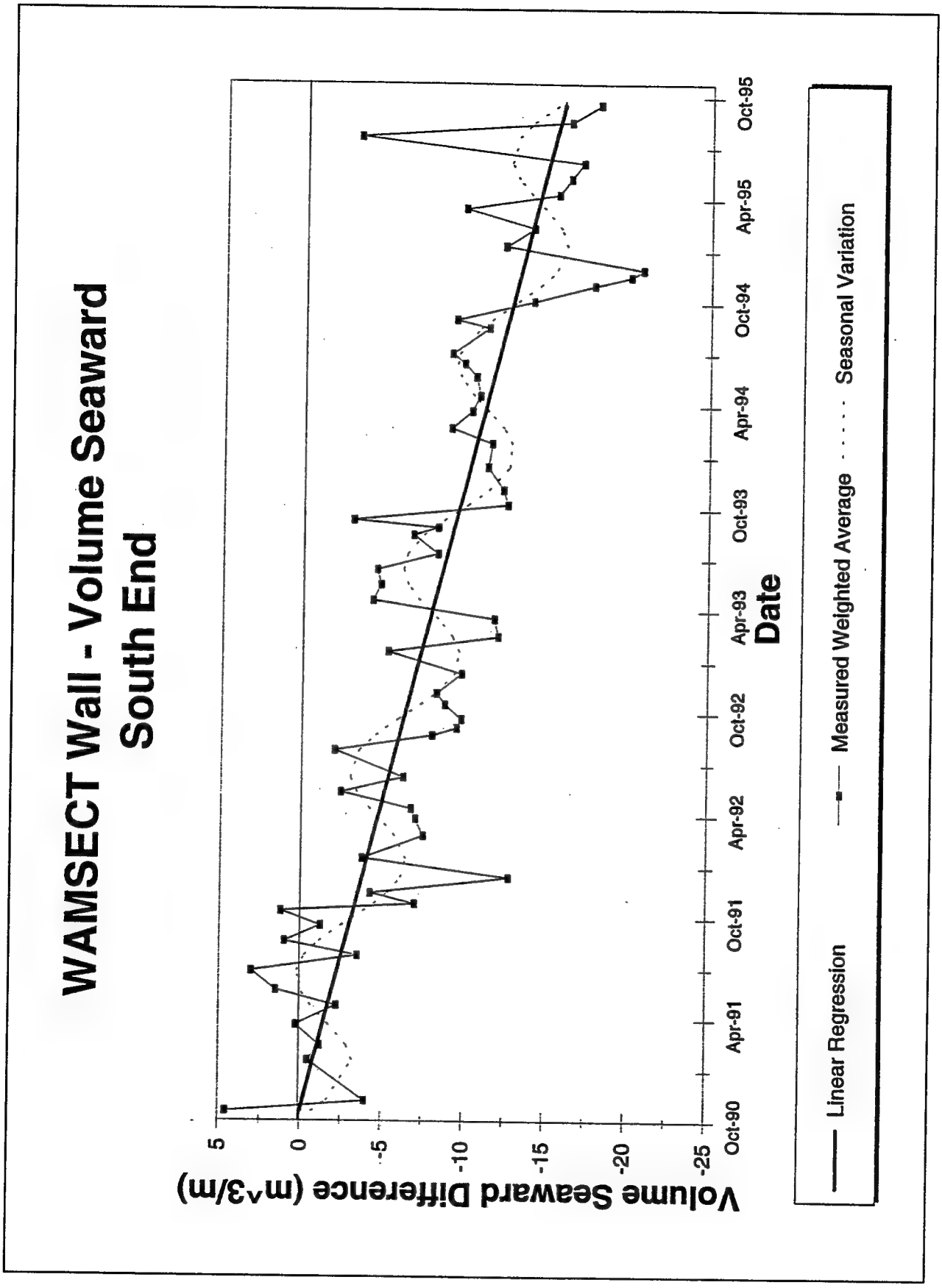

WAMSECT Dune - Volume Seaward
North End
Volume Seaward Difference (m^3/m)
15
10
5
0
-5
-10
-15
Oct-90
Apr-91
Oct-91
Apr-92
Oct-92
Apr-93
Oct-93
Apr-94
Oct-94
Apr-95
Oct-95
Date
Linear Regression
Measured Weighted Average
Seasonal Variation

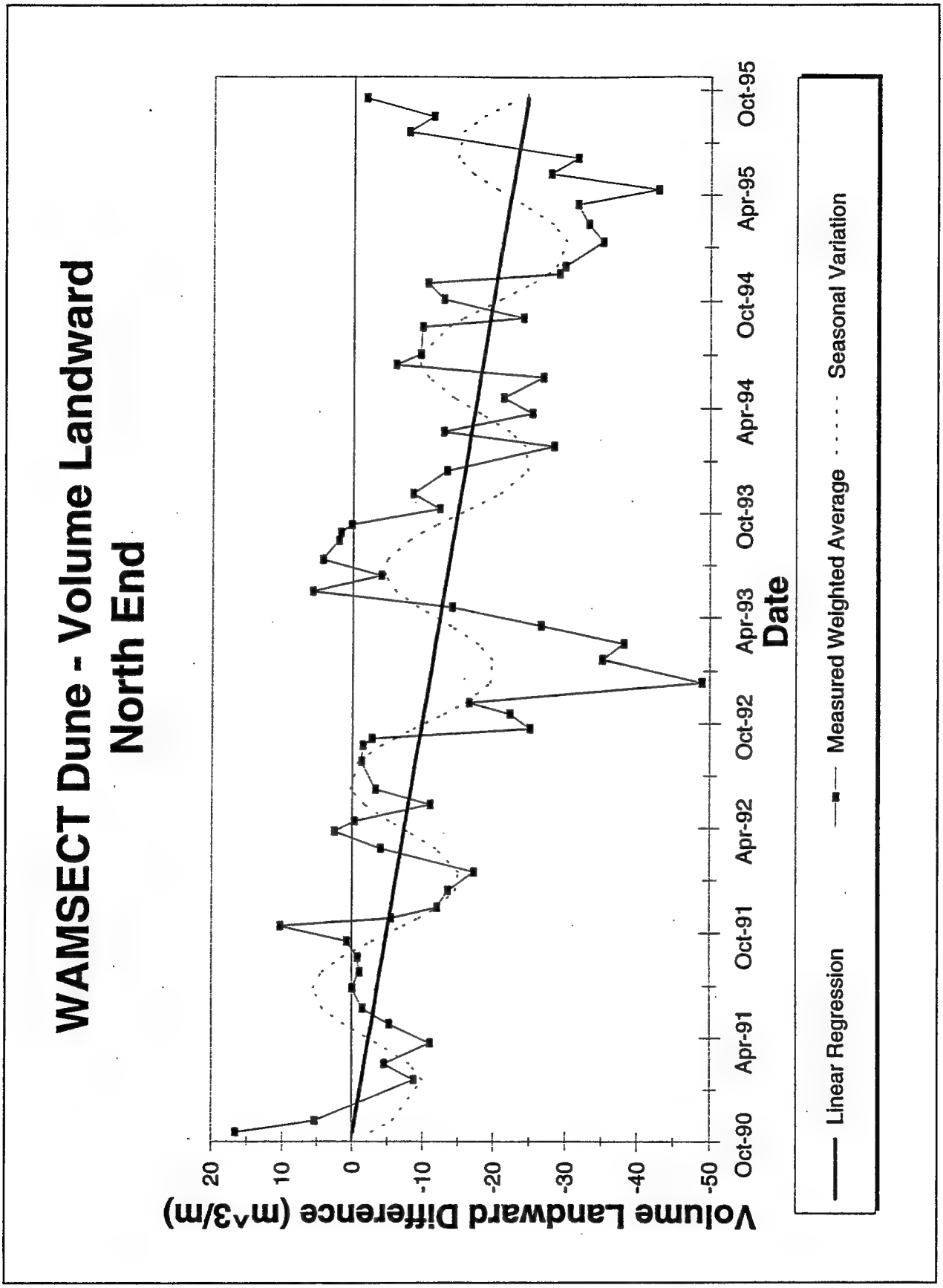

WAMSECT Wall - Volume Seaward
North End
Volume Seaward Difference (m^3/m)
20
10
0
-10
-20
-30
Oct-90
Apr-91
Oct-91
Apr-92
Oct-92
Apr-93
Oct-93
Apr-94
Oct-94
Apr-95
Oct-95
Date
Linear Regression
Measured Weighted Average
Seasonal Variation

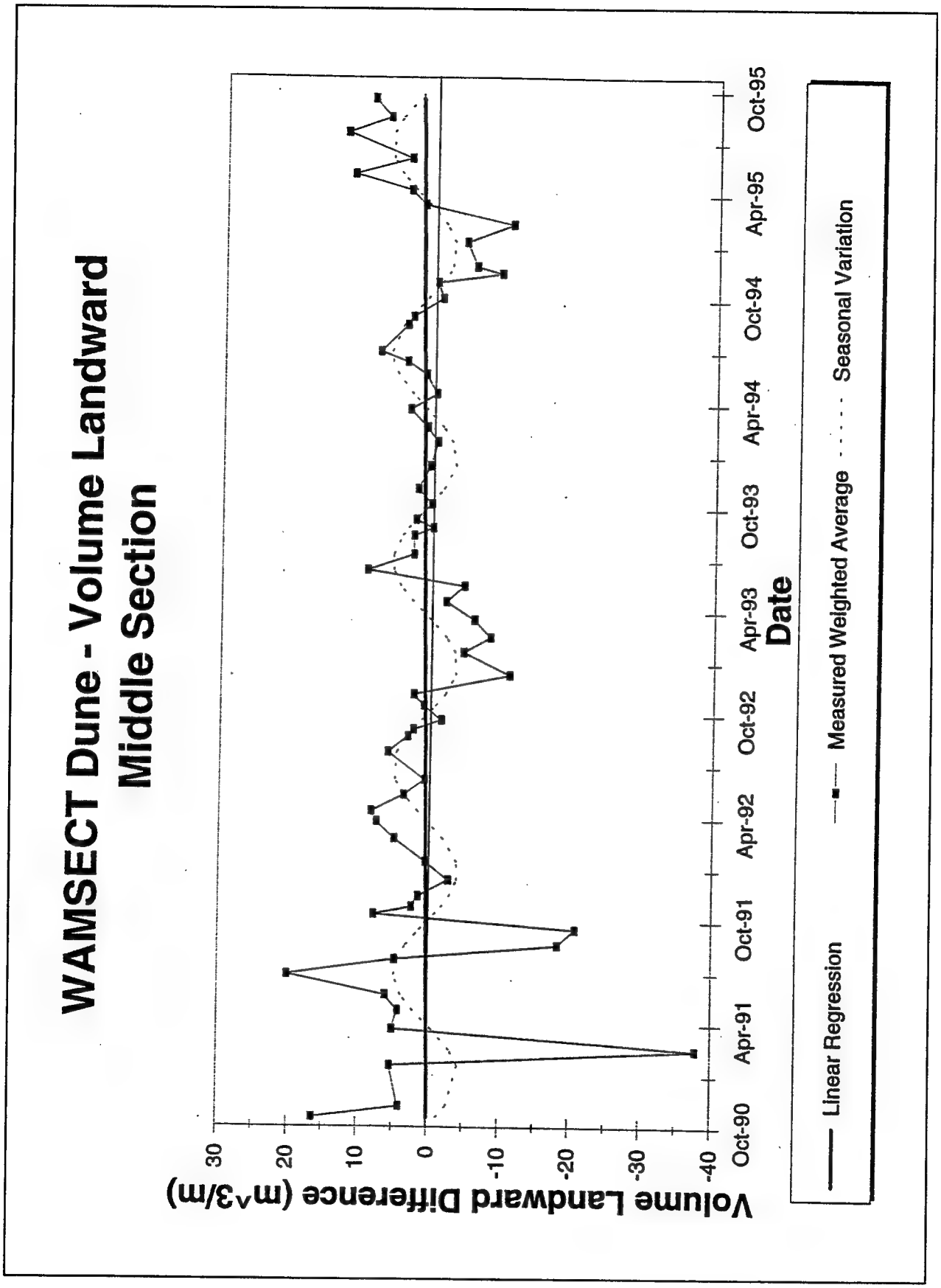

WAMSECT Dune - Volume Seaward
Middle Section
Volume Seaward Difference (m^3/m)
15
10
5
0
-5
-10
-15
-20
Oct-90
Apr-91
Oct-91
Apr-92
Oct-92
Apr-93
Oct-93
Apr-94
Oct-94
Apr-95
Oct-95
Date
Linear Regression
Measured Weighted Average
Seasonal Variation

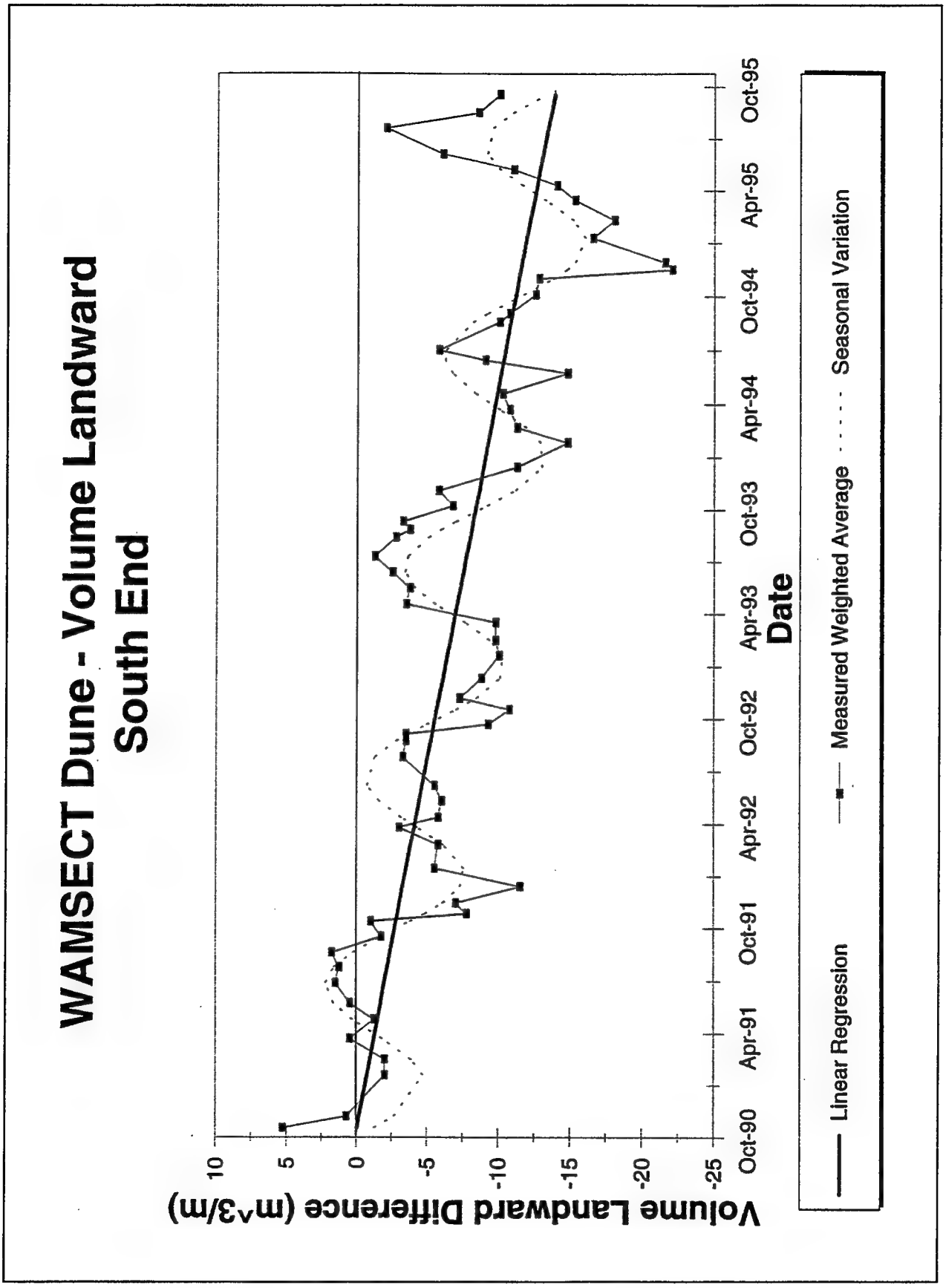

WAMSECT Wall - Volume Seaward
Middle Section
Volume Seaward Difference (m^3/m)
30
20
10
0
-10
-20
Oct-90
Apr-91
Oct-91
Apr-92
Oct-92
Apr-93
Oct-93
Apr-94
Oct-94
Apr-95
Oct-95
Date
Linear Regression
Measured Weighted Average
Seasonal Variation

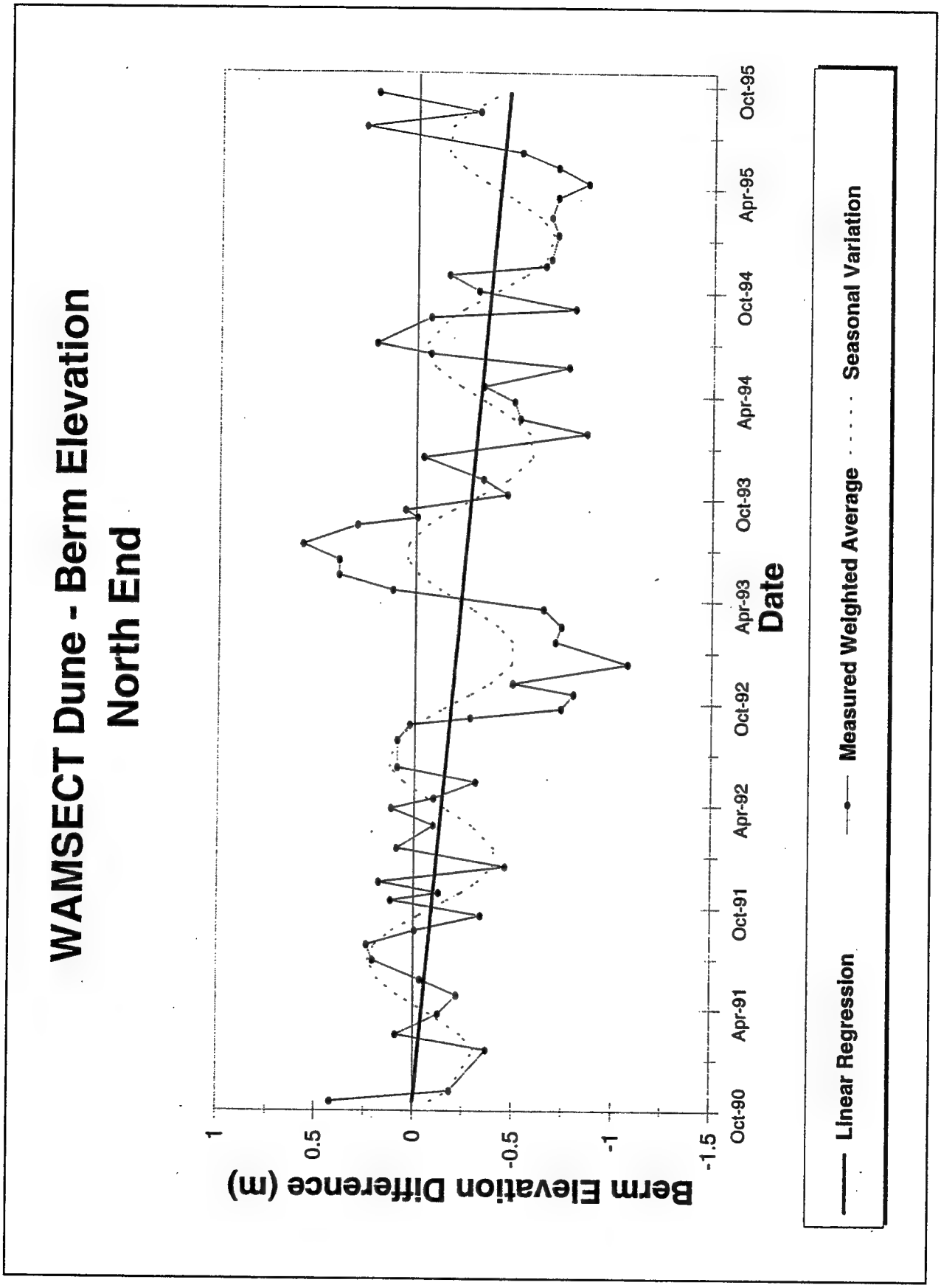

WAMSECT Dune - Volume Seaward
South End
Volume Seaward Difference (m^3/m)
10
0
-10
-20
-30
Oct-90
Apr-91
Oct-91
Apr-92
Oct-92
Apr-93
Oct-93
Apr-94
Oct-94
Apr-95
Oct-95
Date
Linear Regression
Measured Weighted Average
Seasonal Variation

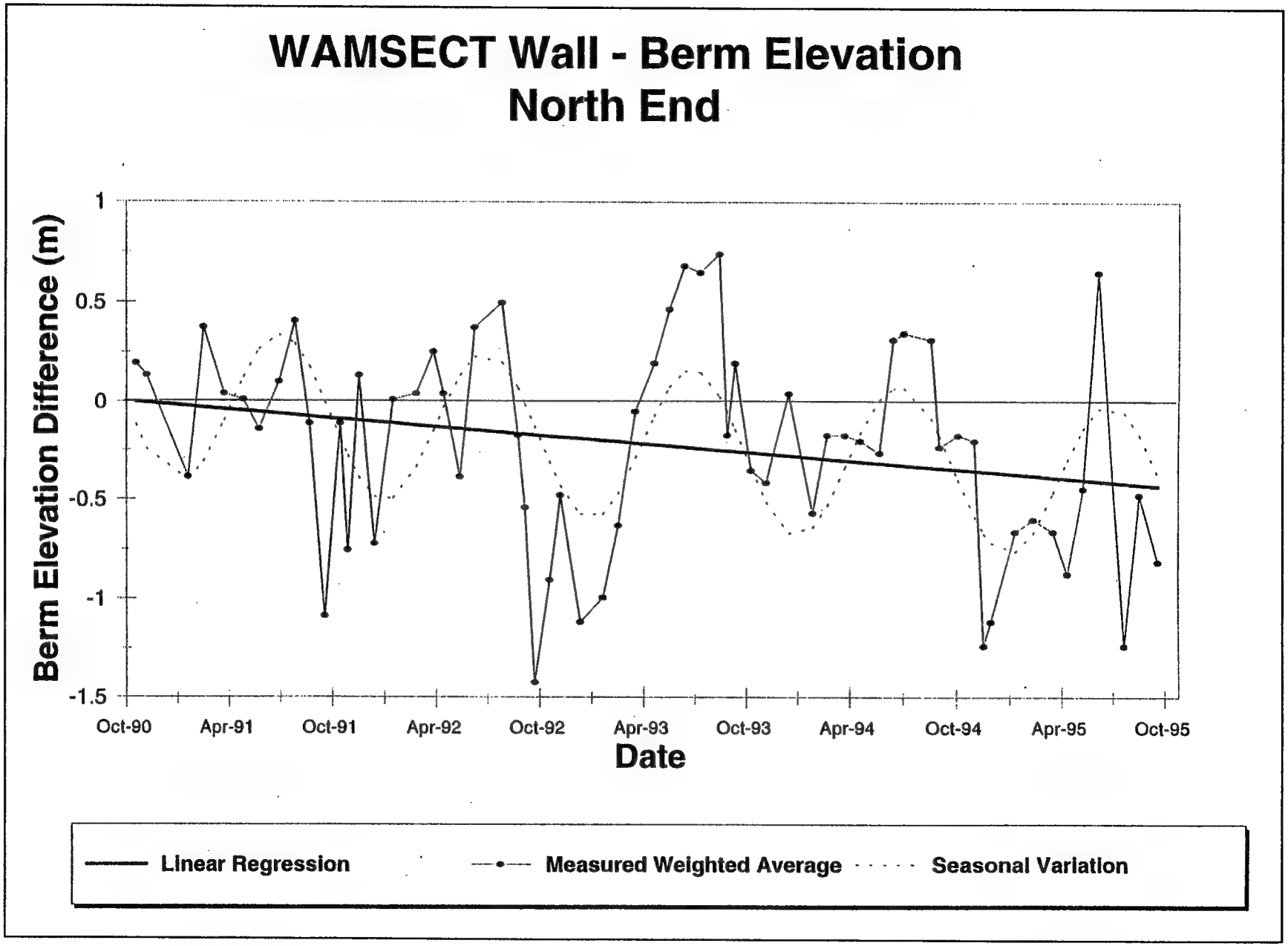

WAMSECT Wall - Volume Seaward
South End
Volume Seaward Difference (m^3/m)
5
0
-5
-10
-15
-20
-25
Oct-90
Apr-91
Oct-91
Apr-92
Oct-92
Apr-93
Oct-93
Apr-94
Oct-94
Apr-95
Oct-95
Date
Linear Regression
Measured Weighted Average
Seasonal Variation

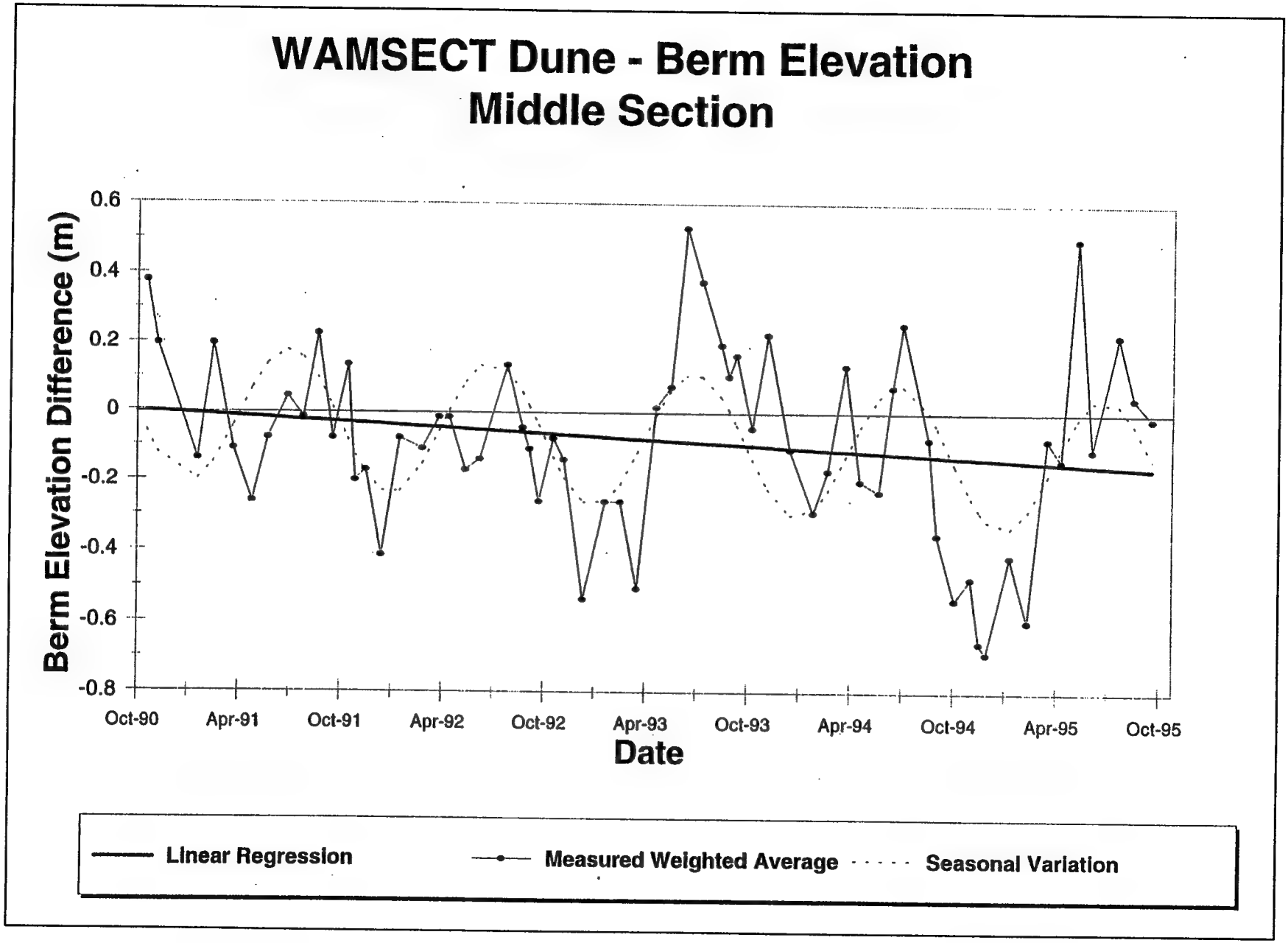

WAMSECT Dune - Volume Landward
North End
Volume Landward Difference (m^3/m)
20
10
0
-10
-20
-30
-40
-50
Oct-90
Apr-91
Oct-91
Apr-92
Oct-92
Apr-93
Oct-93
Apr-94
Oct-94
Apr-95
Oct-95
Date
Linear Regression
Measured Weighted Average
Seasonal Variation

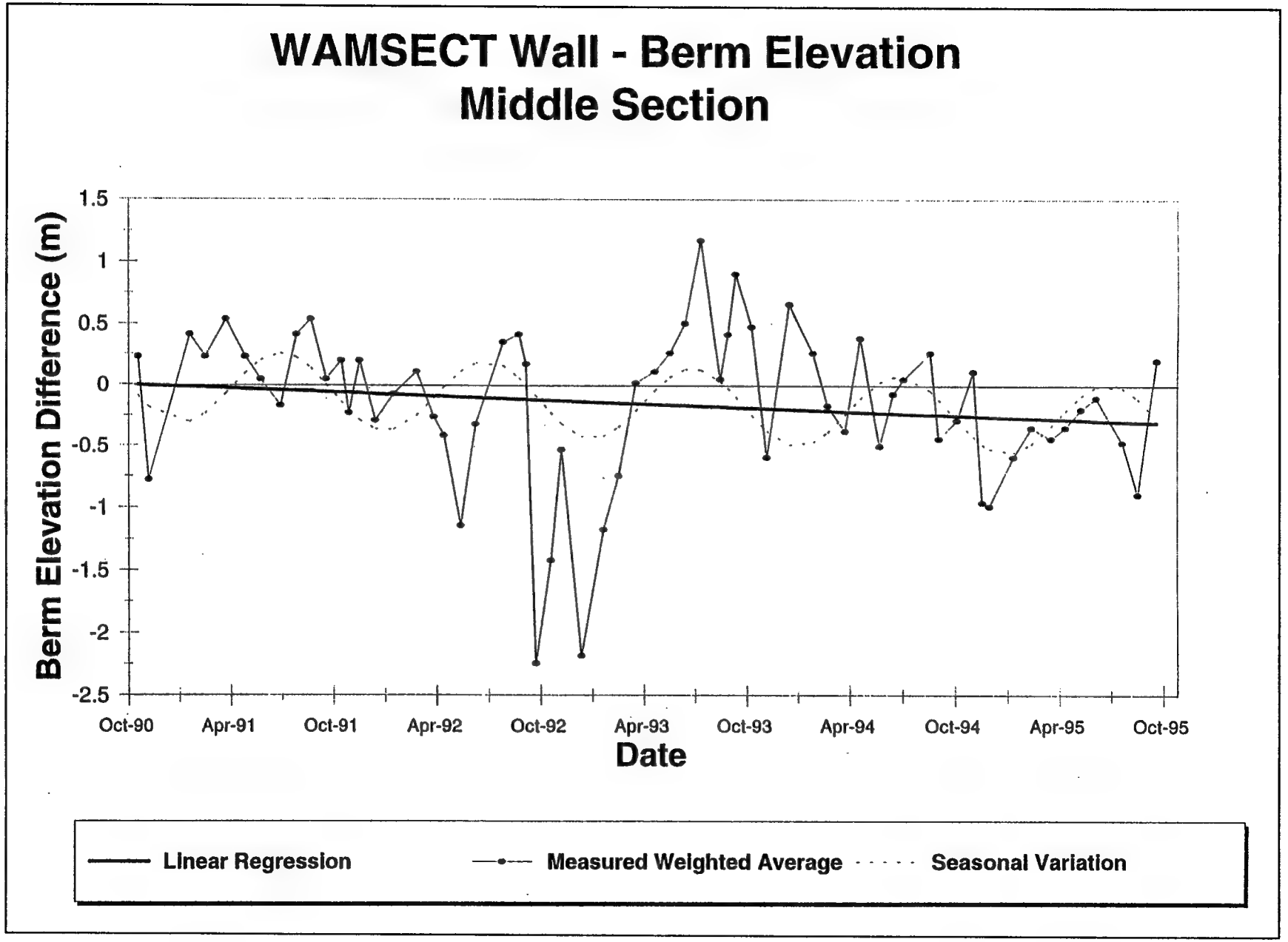

WAMSECT Dune - Volume Landward
Middle Section
Volume Landward Difference (m^3/m)
30
20
10
0
-10
-20
-30
-40
Oct-90
Apr-91
Oct-91
Apr-92
Oct-92
Apr-93
Oct-93
Apr-94
Oct-94
Apr-95
Oct-95
Date
Linear Regression
Measured Weighted Average
Seasonal Variation

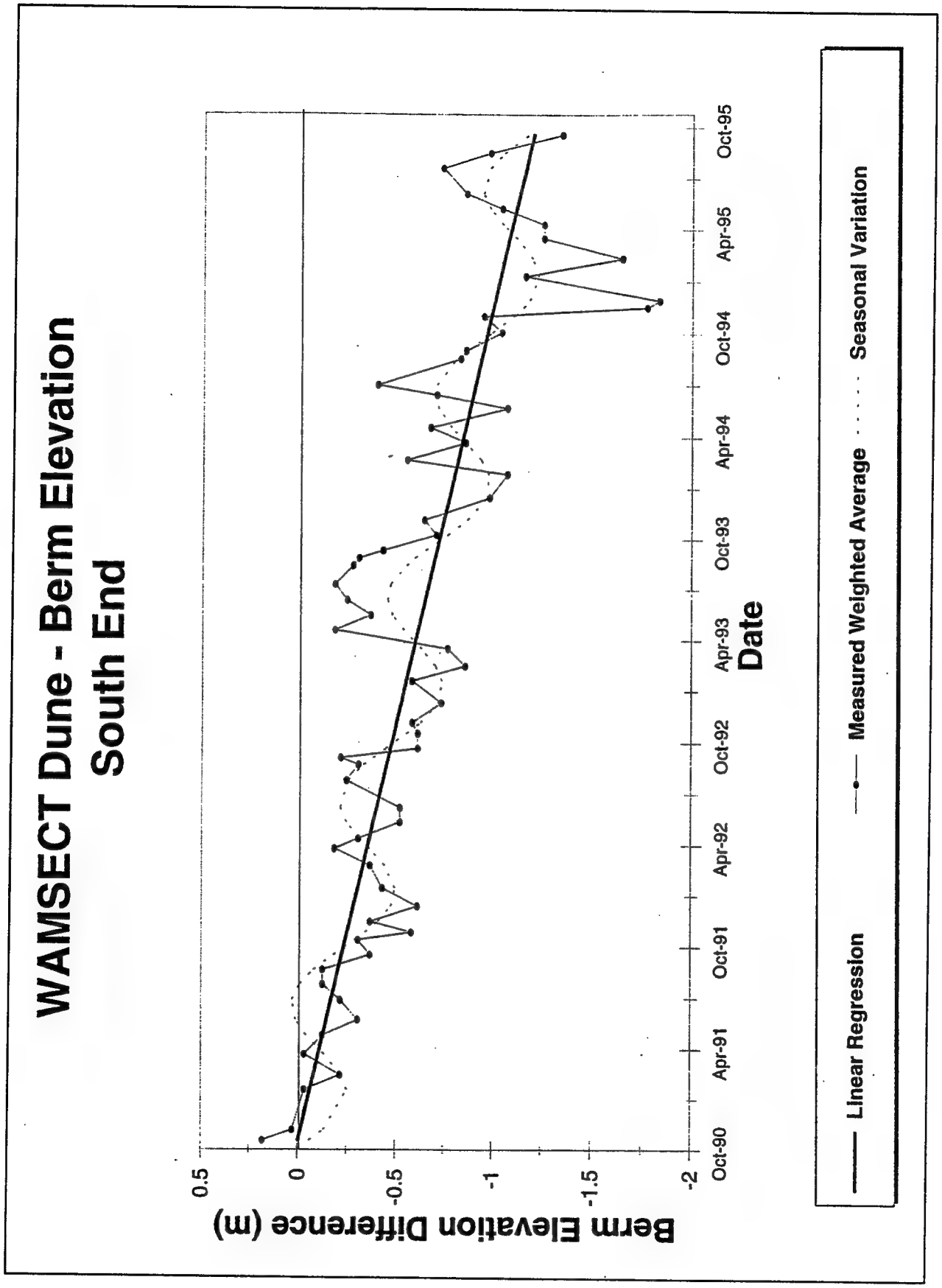

WAMSECT Dune - Volume Landward
South End
Volume Landward Difference (m^3/m)
10
5
0
-5
-10
-15
-20
-25
Oct-90
Apr-91
Oct-91
Apr-92
Oct-92
Apr-93
Oct-93
Apr-94
Oct-94
Apr-95
Oct-95
Date
Linear Regression
Measured Weighted Average
Seasonal Variation

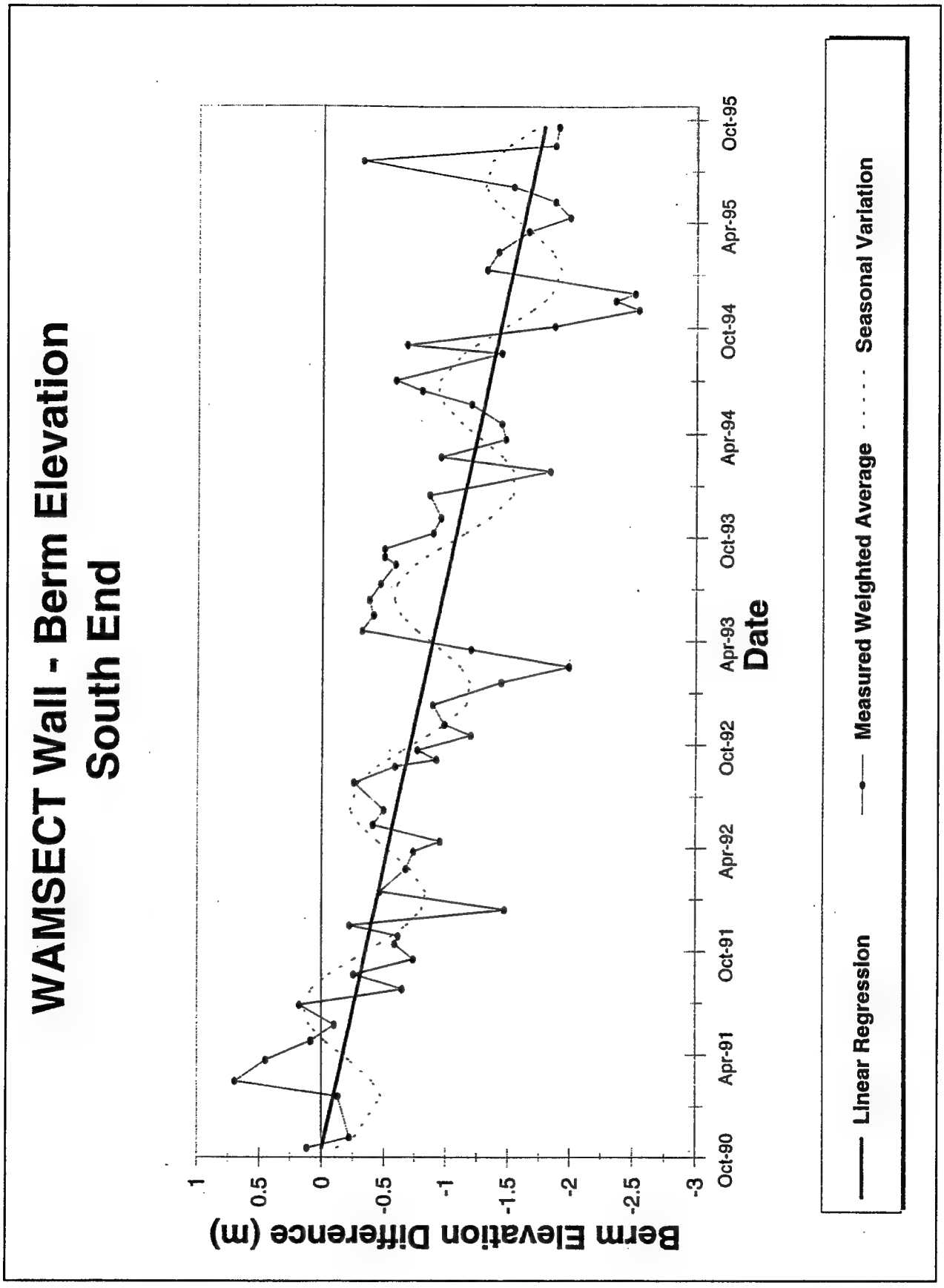

WAMSECT Dune - Berm Elevation
North End
Berm Elevation Difference (m)
1
0.5
0
-0.5
-1
-1.5
Oct-90
Apr-91
Oct-91
Apr-92
Oct-92
Apr-93
Oct-93
Apr-94
Oct-94
Apr-95
Oct-95
Date
Linear Regression
Measured Weighted Average
Seasonal Variation

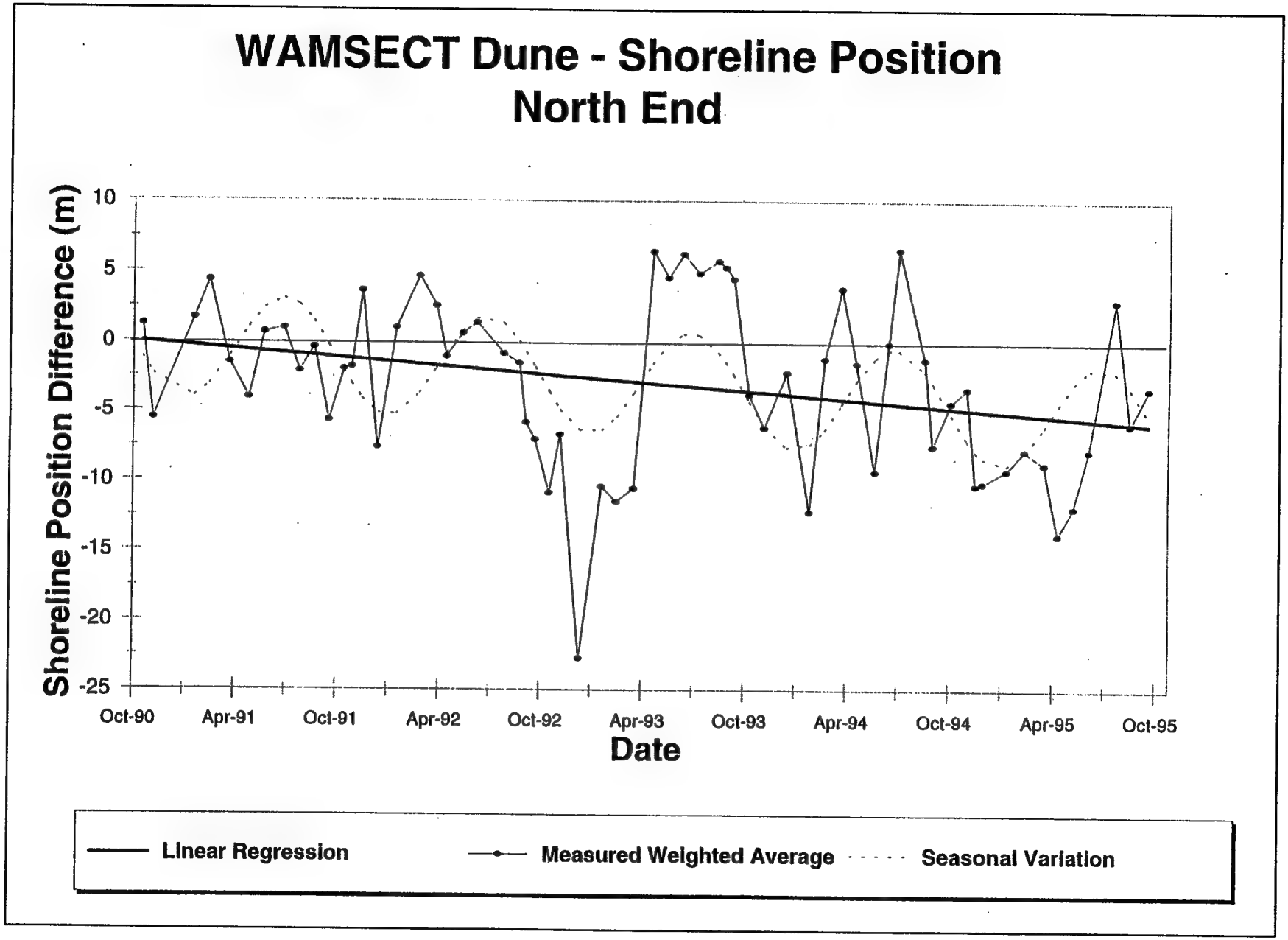

WAMSECT Wall - Berm Elevation
North End
Berm Elevation Difference (m)
1
0.5
0
-0.5
-1
-1.5
Oct-90
Apr-91
Oct-91
Apr-92
Oct-92
Apr-93
Oct-93
Apr-94
Oct-94
Apr-95
Oct-95
Date
Linear Regression
Measured Weighted Average
Seasonal Variation

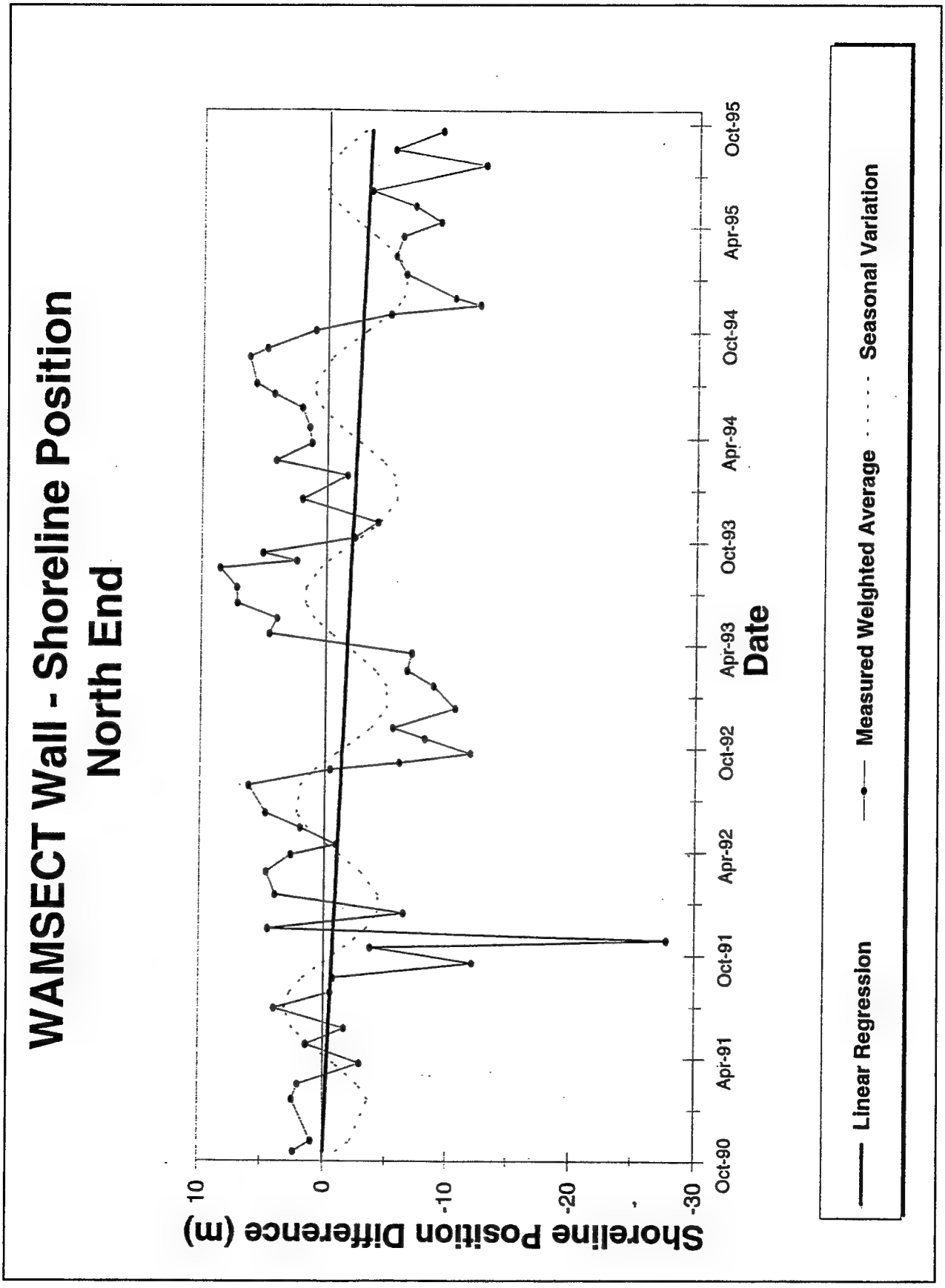

WAMSECT Dune - Berm Elevation
Middle Section
Berm Elevation Difference (m)
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
Oct-90
Apr-91
Oct-91
Apr-92
Oct-92
Apr-93
Oct-93
Apr-94
Oct-94
Apr-95
Oct-95
Date
Linear Regression
Measured Weighted Average
Seasonal Variation

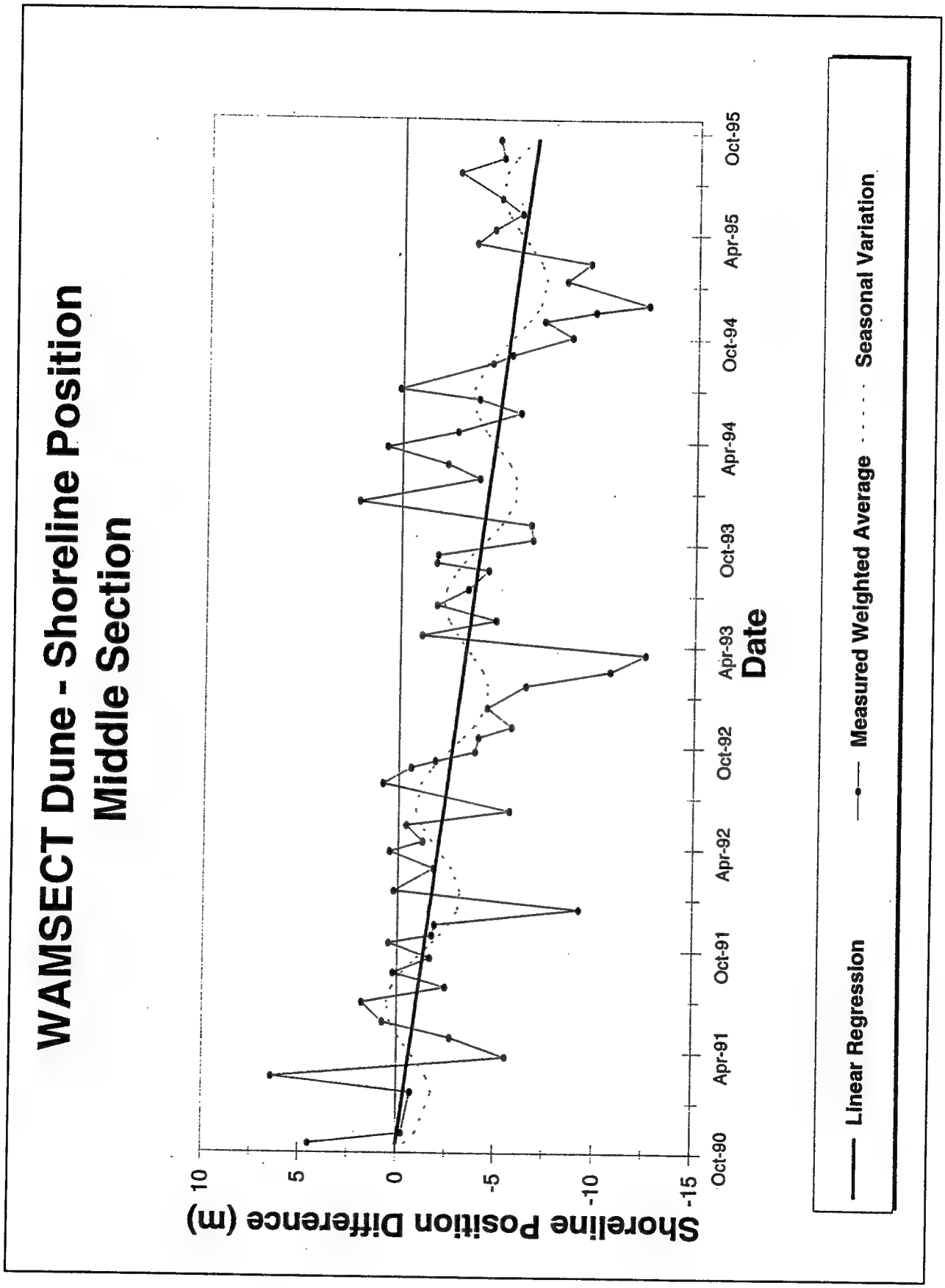

WAMSECT Wall - Berm Elevation
Middle Section
Berm Elevation Difference (m)
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
Oct-90
Apr-91
Oct-91
Apr-92
Oct-92
Apr-93
Oct-93
Apr-94
Oct-94
Apr-95
Oct-95
Date
Linear Regression
Measured Weighted Average
Seasonal Variation

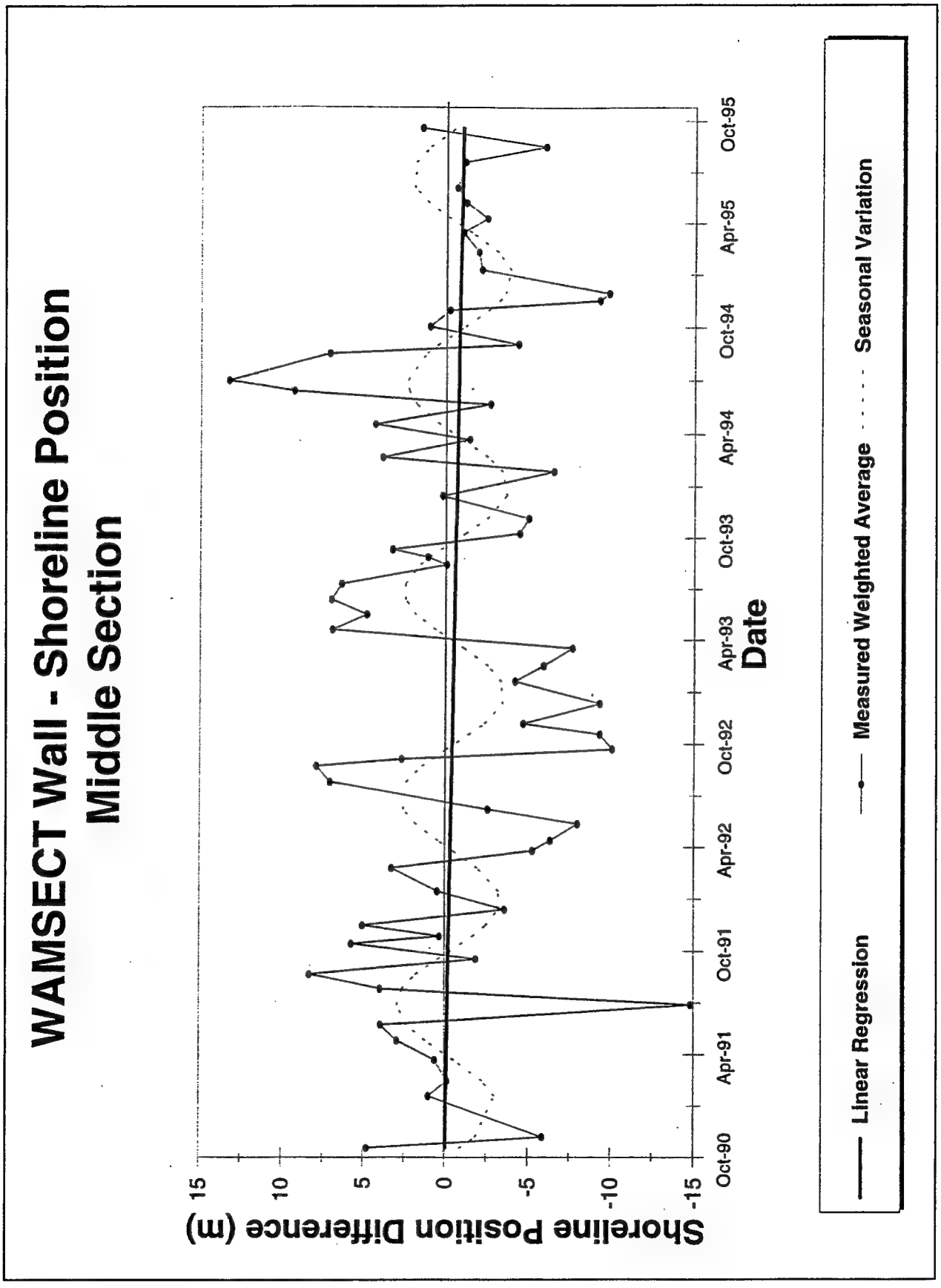

WAMSECT Dune - Berm Elevation
South End
Berm Elevation Difference (m)
0.5
0
-0.5
-1
-1.5
-2
Oct-90
Apr-91
Oct-91
Apr-92
Oct-92
Apr-93
Oct-93
Apr-94
Oct-94
Apr-95
Oct-95
Date
Linear Regression
Measured Weighted Average
Seasonal Variation

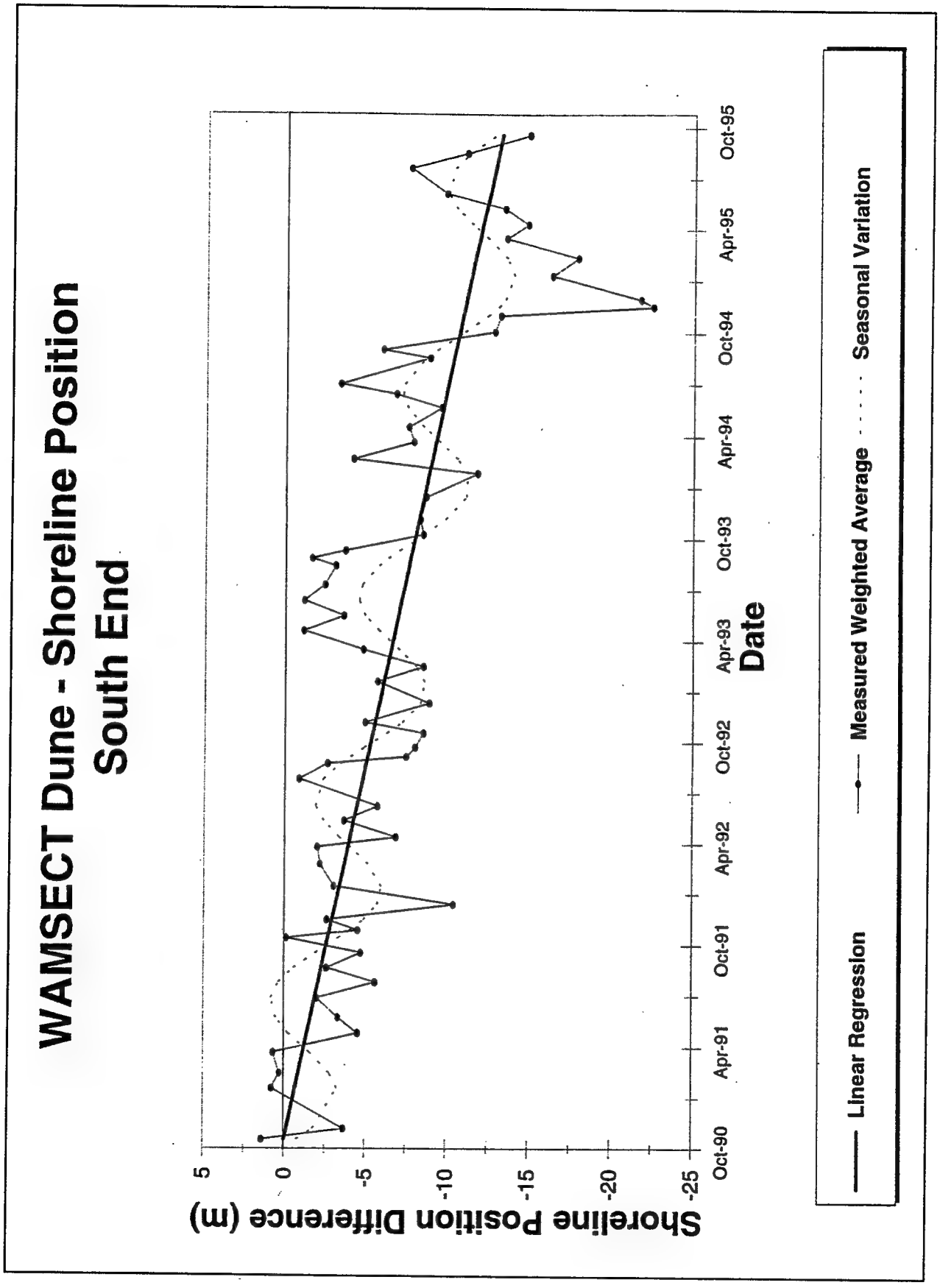

WAMSECT Wall - Berm Elevation
South End
Berm Elevation Difference (m)
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
Oct-90
Apr-91
Oct-91
Apr-92
Oct-92
Apr-93
Oct-93
Apr-94
Oct-94
Apr-95
Oct-95
Date
Linear Regression
Measured Weighted Average
Seasonal Variation

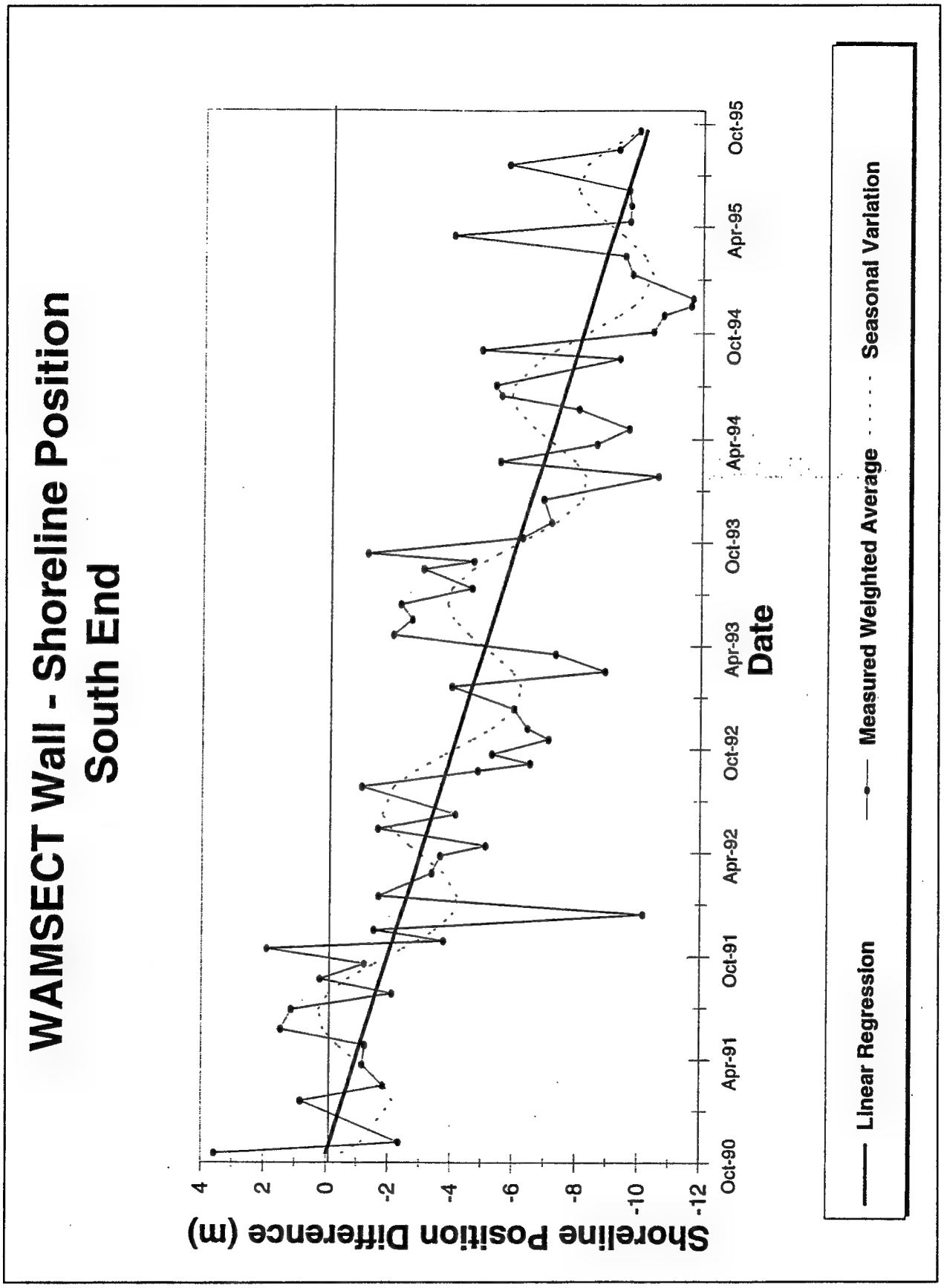

WAMSECT Dune - Shoreline Position
North End
Shoreline Position Difference (m)
10
5
0
-5
-10
-15
-20
-25
Oct-90
Apr-91
Oct-91
Apr-92
Oct-92
Apr-93
Oct-93
Apr-94
Oct-94
Apr-95
Oct-95
Date
Linear Regression
Measured Weighted Average
Seasonal Variation


WAMSECT Wall - Shoreline Position
North End
Shoreline Position Difference (m)
10
0
-10
-20
-30
Oct-90
Apr-91
Oct-91
Apr-92
Oct-92
Apr-93
Oct-93
Apr-94
Oct-94
Apr-95
Oct-95
Date
Linear Regression
Measured Weighted Average
Seasonal Variation

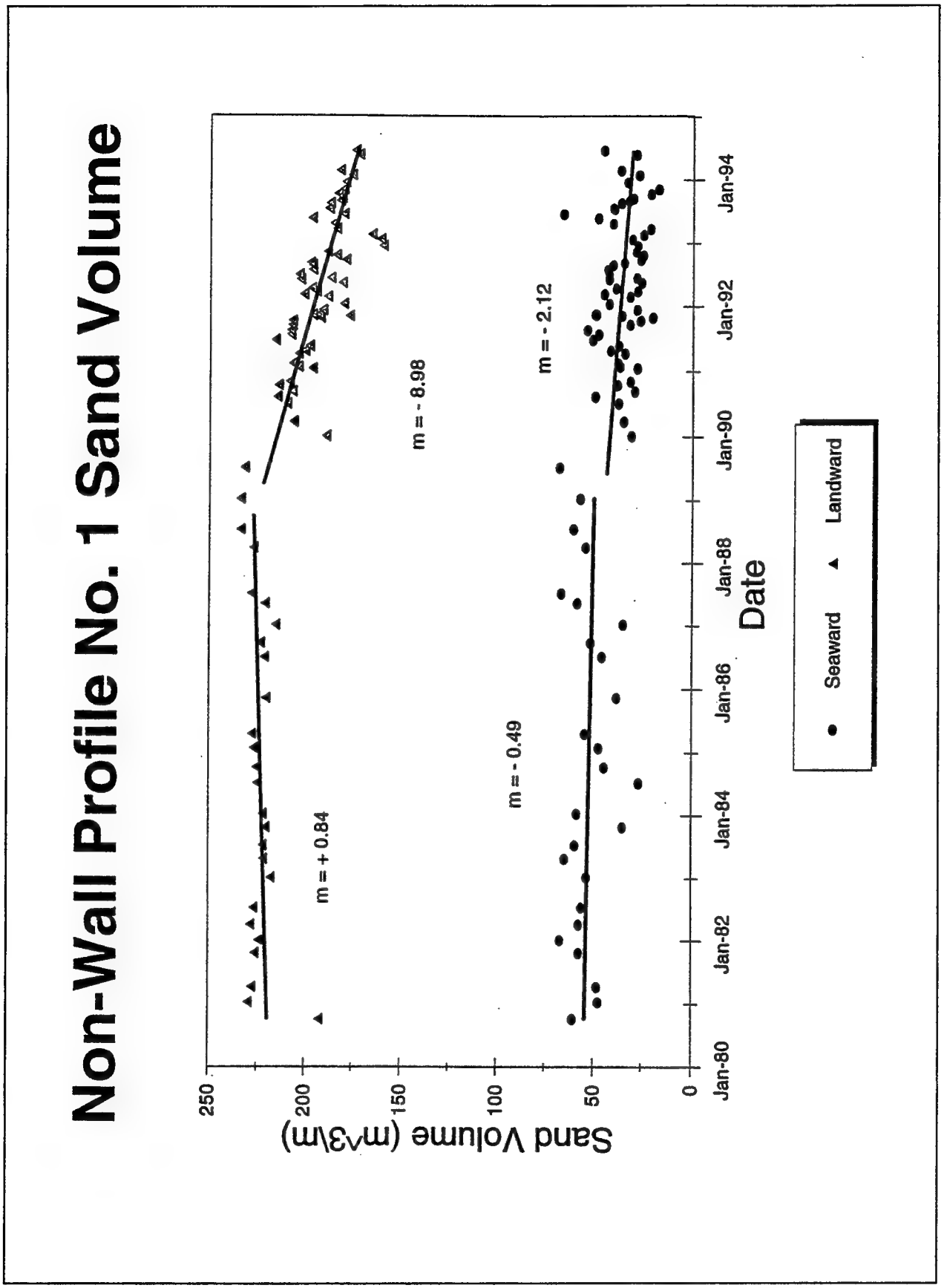

WAMSECT Dune - Shoreline Position
Middle Section
Shoreline Position Difference (m)
10
5
0
-5
-10
-15
Oct-90
Apr-91
Oct-91
Apr-92
Oct-92
Apr-93
Oct-93
Apr-94
Oct-94
Apr-95
Oct-95
Date
Linear Regression
Measured Weighted Average
Seasonal Variation

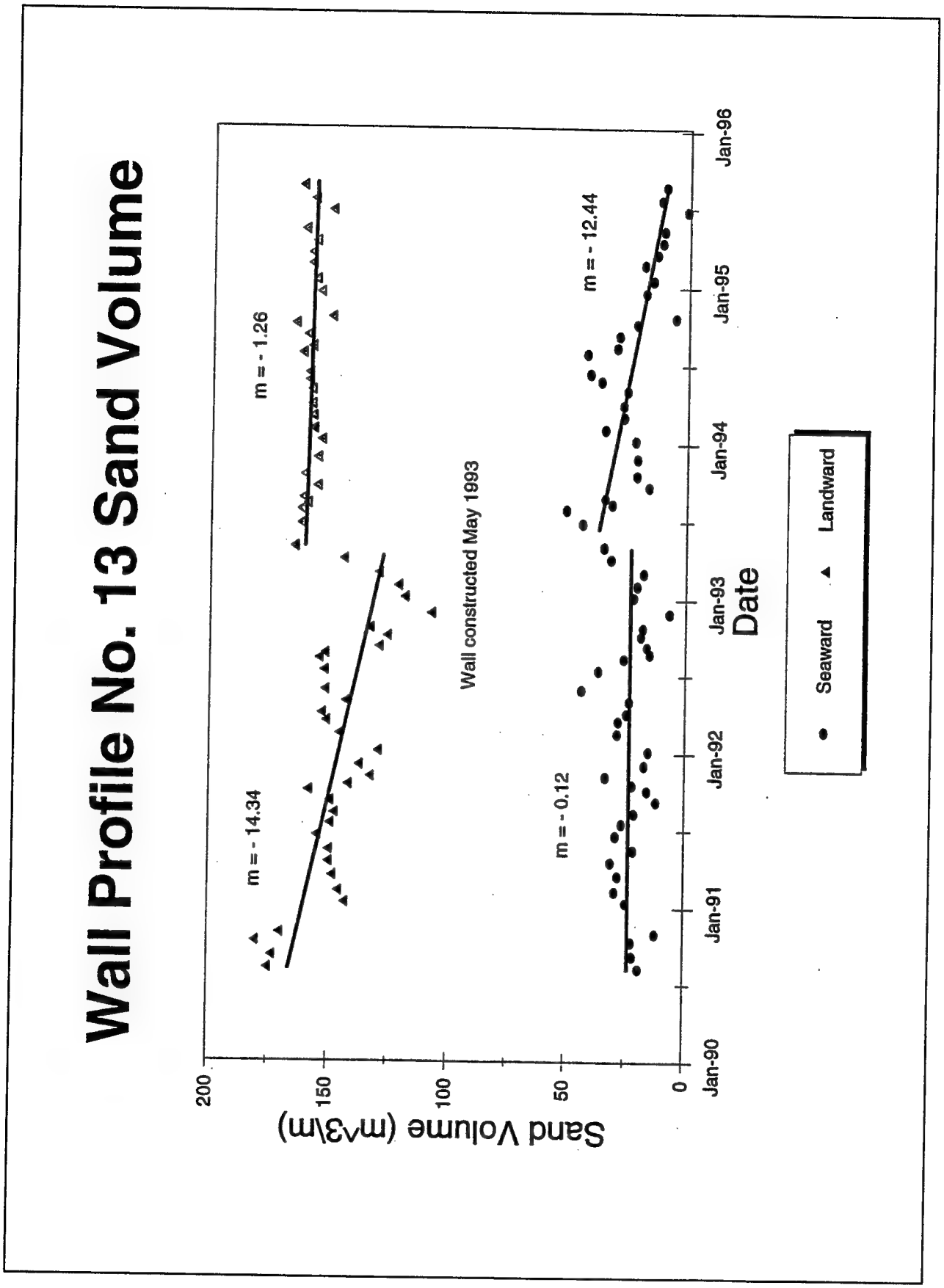

WAMSECT Wall - Shoreline Position
Middle Section
Shoreline Position Difference (m)
15
10
5
0
-5
-10
-15
Oct-90
Apr-91
Oct-91
Apr-92
Oct-92
Apr-93
Oct-93
Apr-94
Oct-94
Apr-95
Oct-95
Date
Linear Regression
Measured Weighted Average
Seasonal Variation

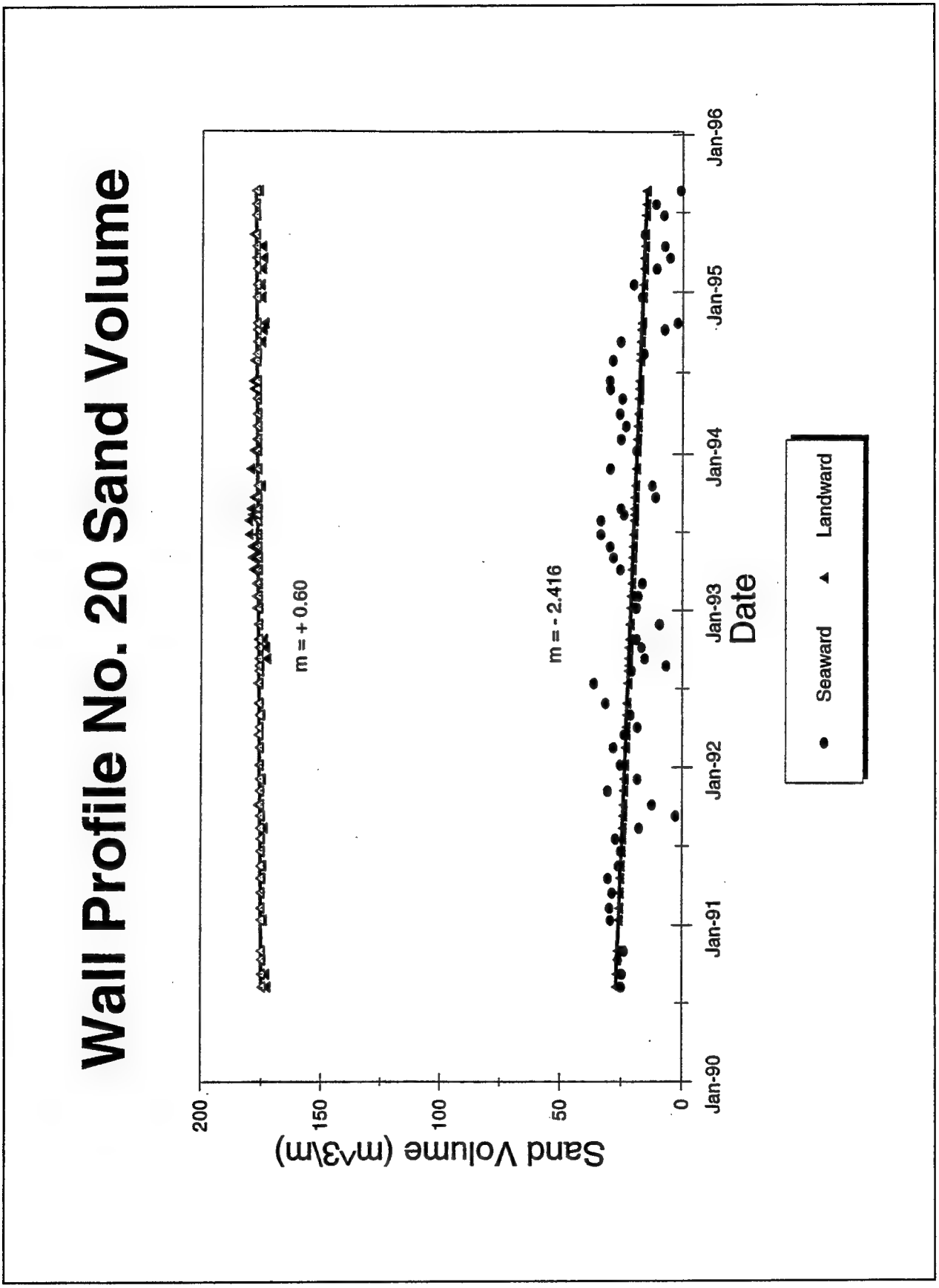

WAMSECT Dune - Shoreline Position
South End
Shoreline Position Difference (m)
5
0
-5
-10
-15
-20
-25
Oct-90
Apr-91
Oct-91
Apr-92
Oct-92
Apr-93
Oct-93
Apr-94
Oct-94
Apr-95
Oct-95
Date
Linear Regression
Measured Weighted Average
Seasonal Variation

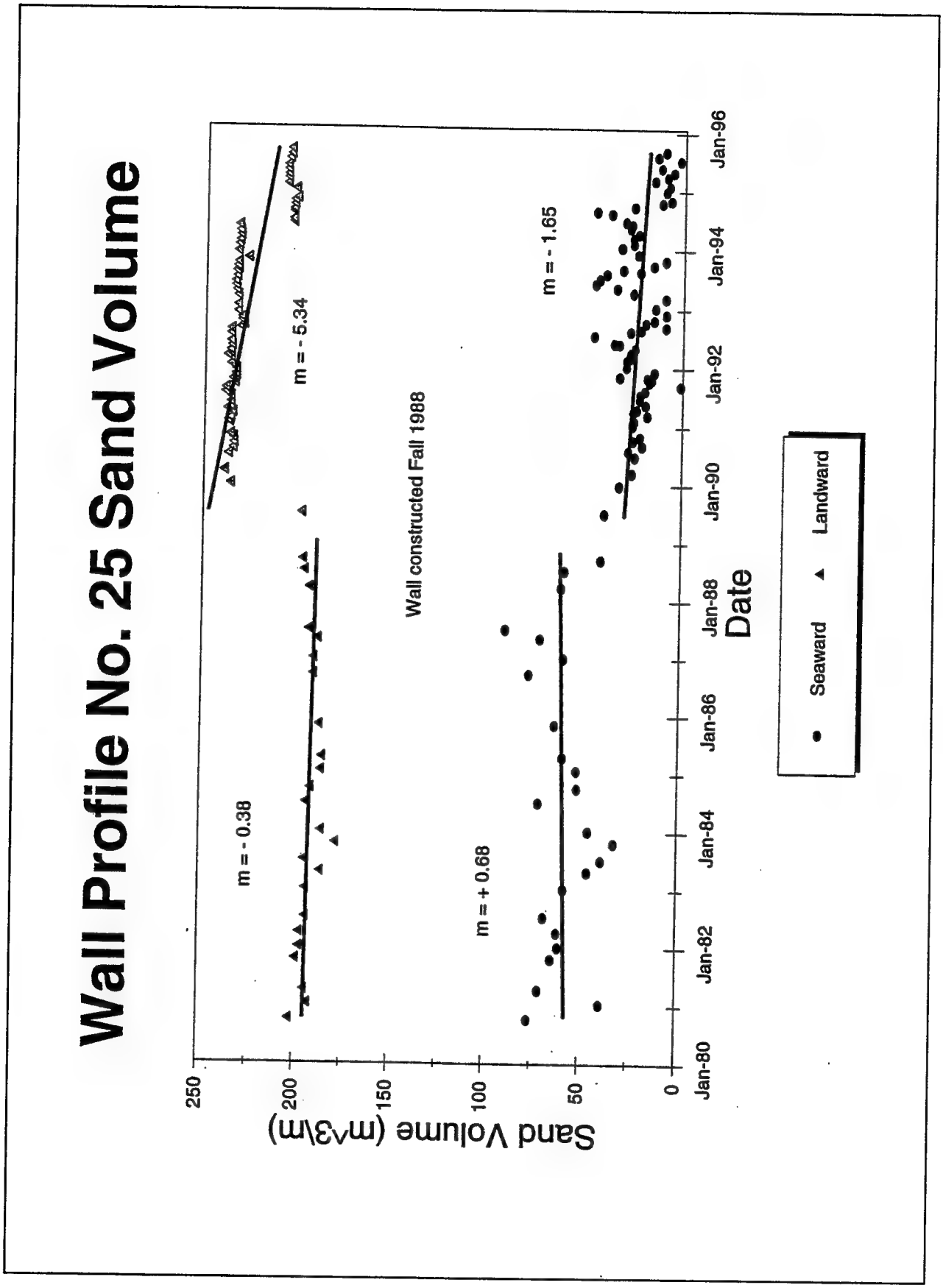

WAMSECT Wall - Shoreline Position
South End
Shoreline Position Difference (m)
4
2
0
-2
-4
-6
-8
-10
-12
Oct-90
Apr-91
Oct-91
Apr-92
Oct-92
Apr-93
Oct-93
Apr-94
Oct-94
Apr-95
Oct-95
Date
Linear Regression
Measured Weighted Average
Seasonal Variation

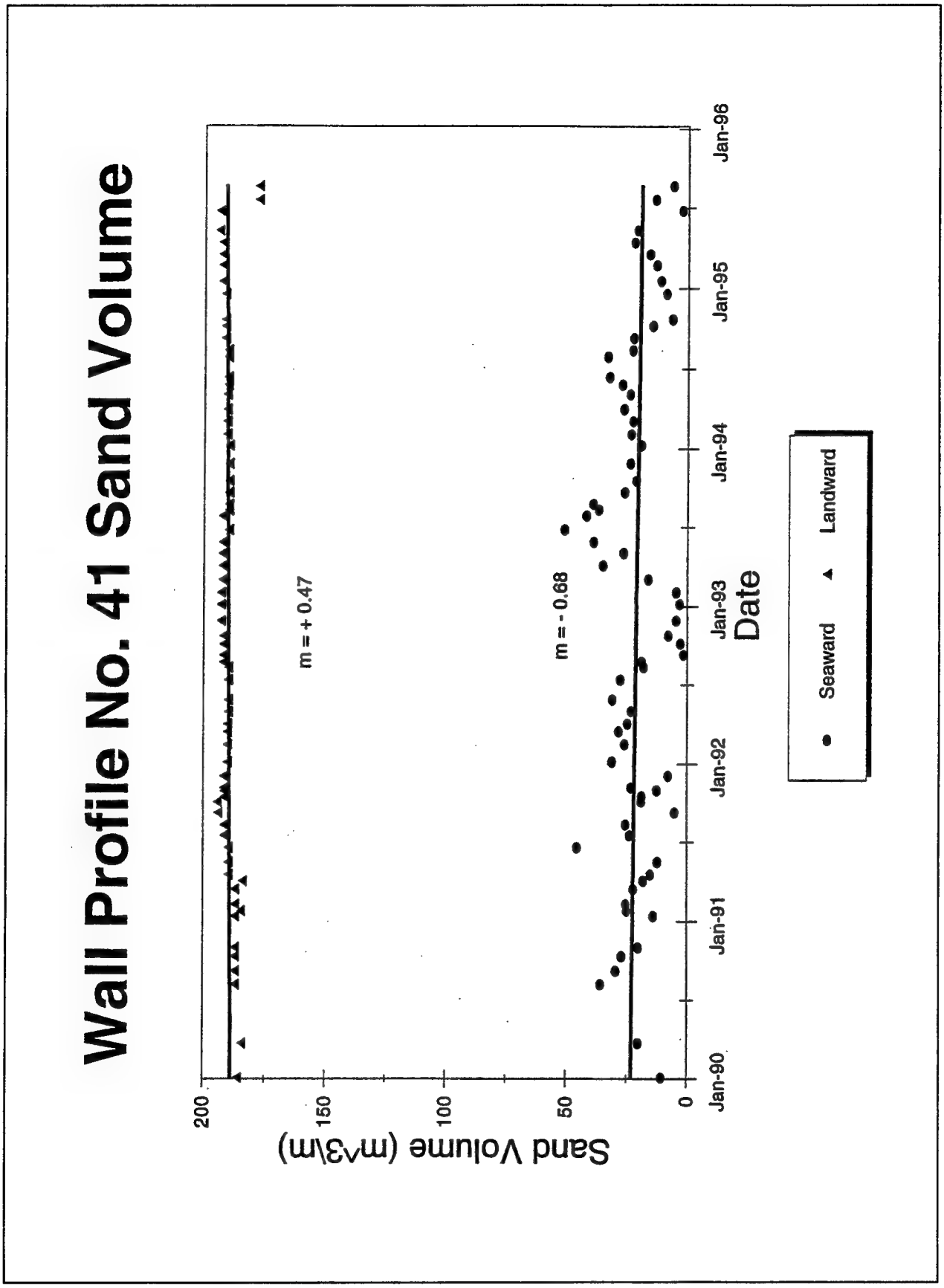
Appendix C
Individual Profile Method (IPM) Results

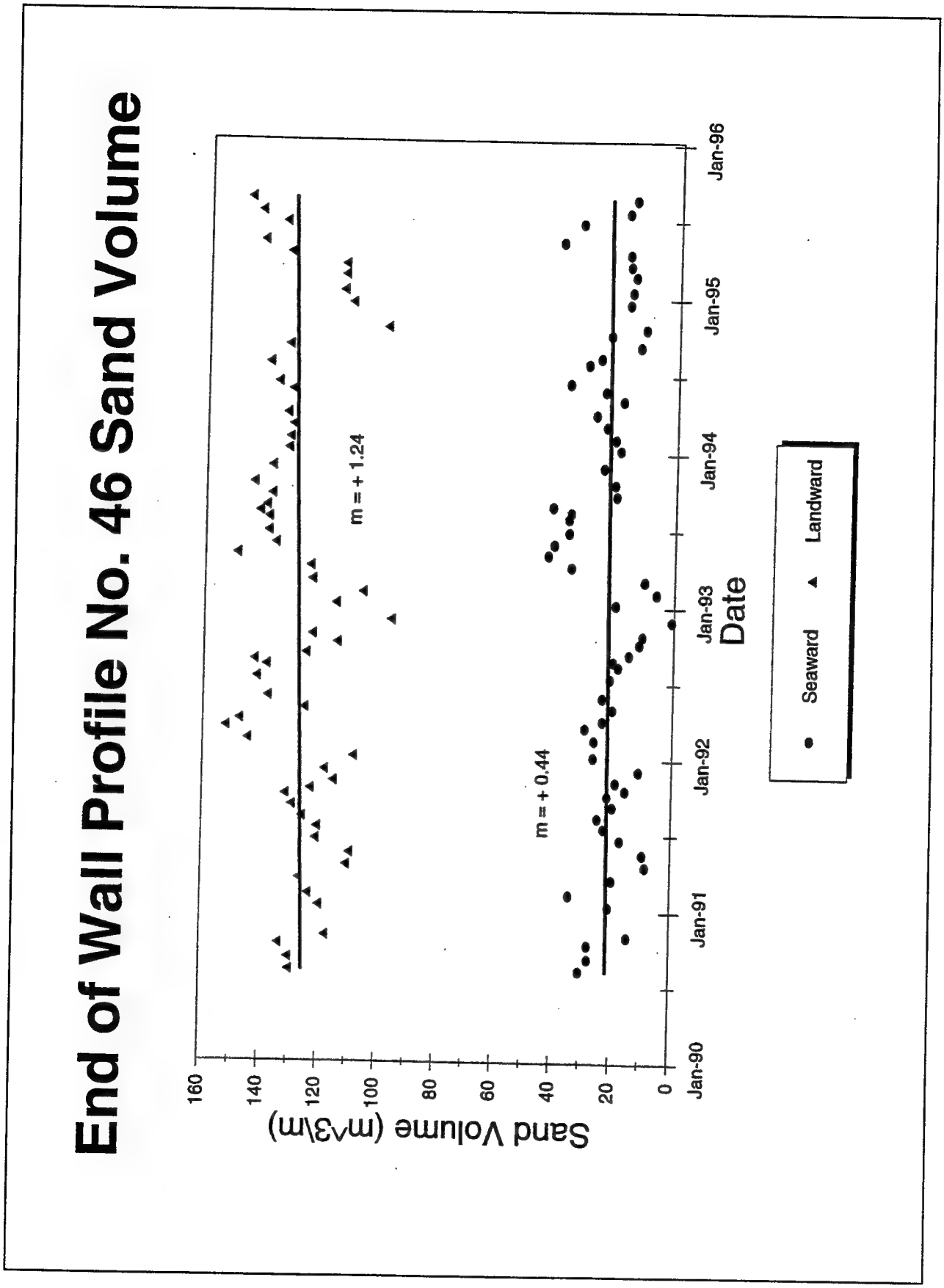

Non-Wall Profile No. 1 Sand Volume
Sand Volume (m^3/m)
250
200
150
100
50
0
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Date
m = + 0.84
m = - 8.98
m = - 0.49
m = - 2.12
Seaward
Landward

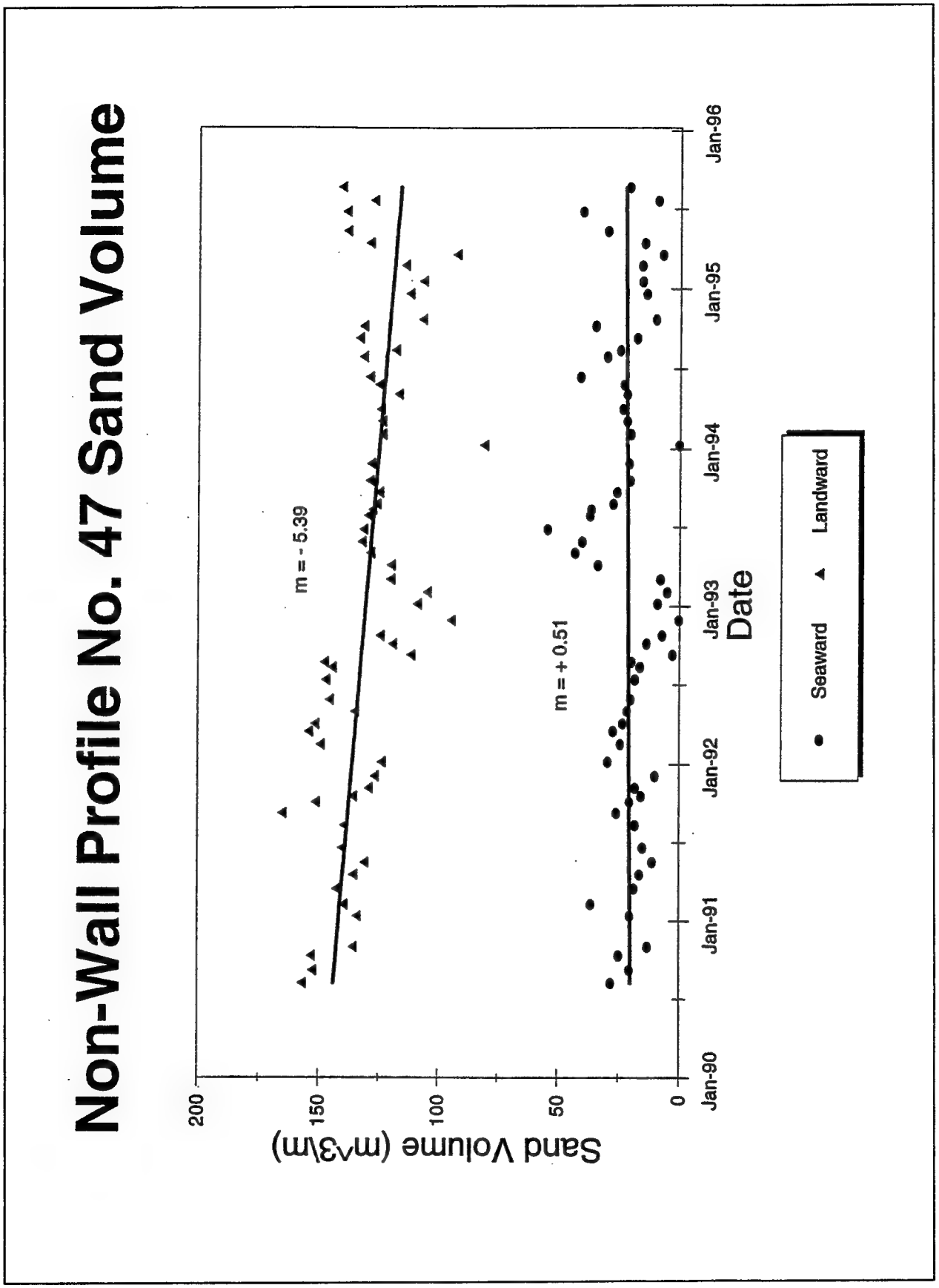

Wall Profile No. 13 Sand Volume
Sand Volume (m^3/m)
200
150
100
50
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Date
m = - 14.34
m = - 1.26
m = - 0.12
m = - 12.44
Wall constructed May 1993
Seaward
Landward

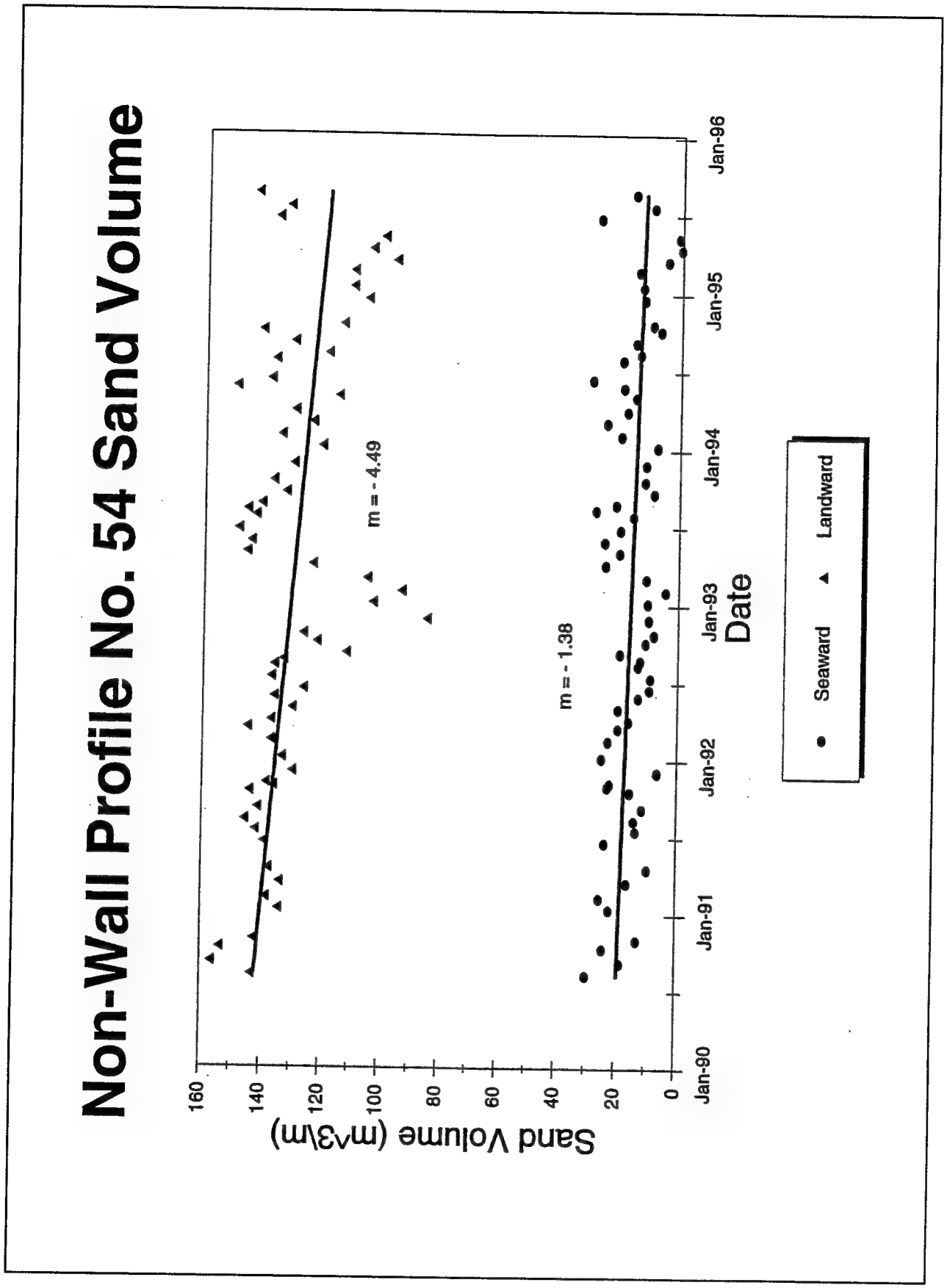

Wall Profile No. 20 Sand Volume
Sand Volume (m^3\m)
200
150
100
50
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Date
m = + 0.60
m = - 2.416
Seaward
Landward

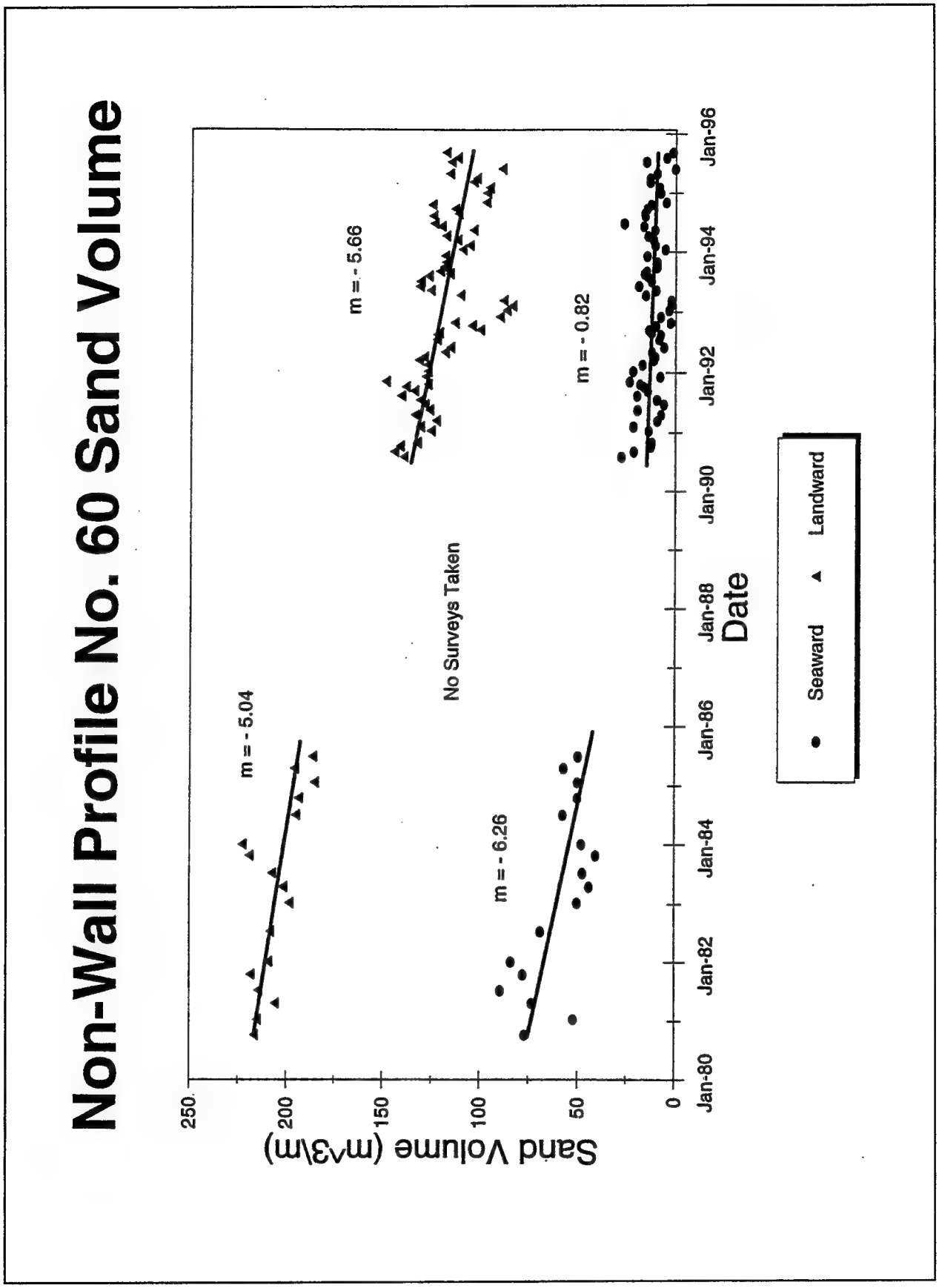

Wall Profile No. 25 Sand Volume
Sand Volume (m^3\m)
250
200
150
100
50
0
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Date
m = - 0.38
m = - 5.34
m = + 0.68
m = - 1.65
Wall constructed Fall 1988
Seaward
Landward

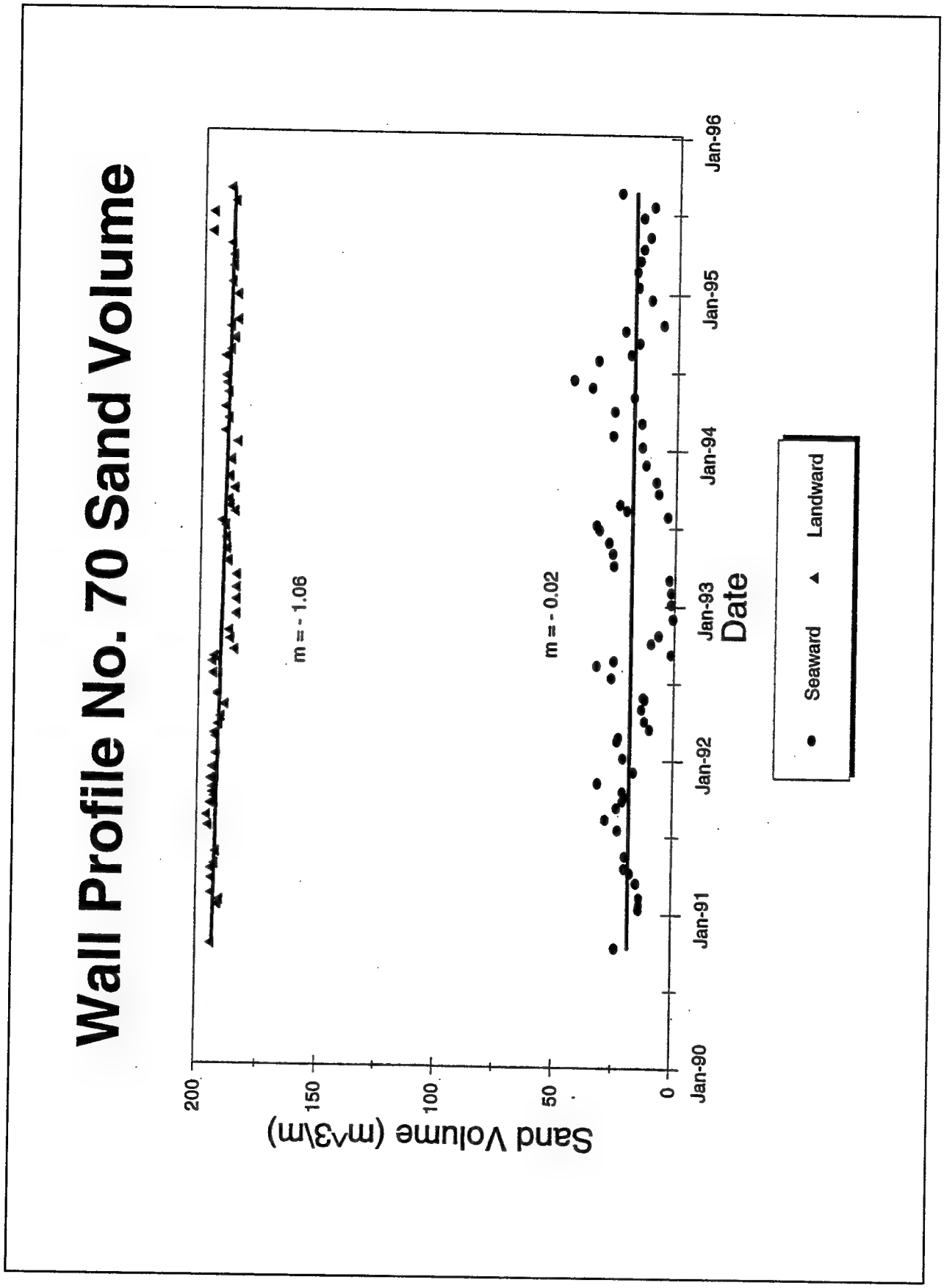

Wall Profile No. 41 Sand Volume
Sand Volume (m^3\m)
200
150
100
50
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Date
m = + 0.47
m = - 0.68
Seaward
Landward

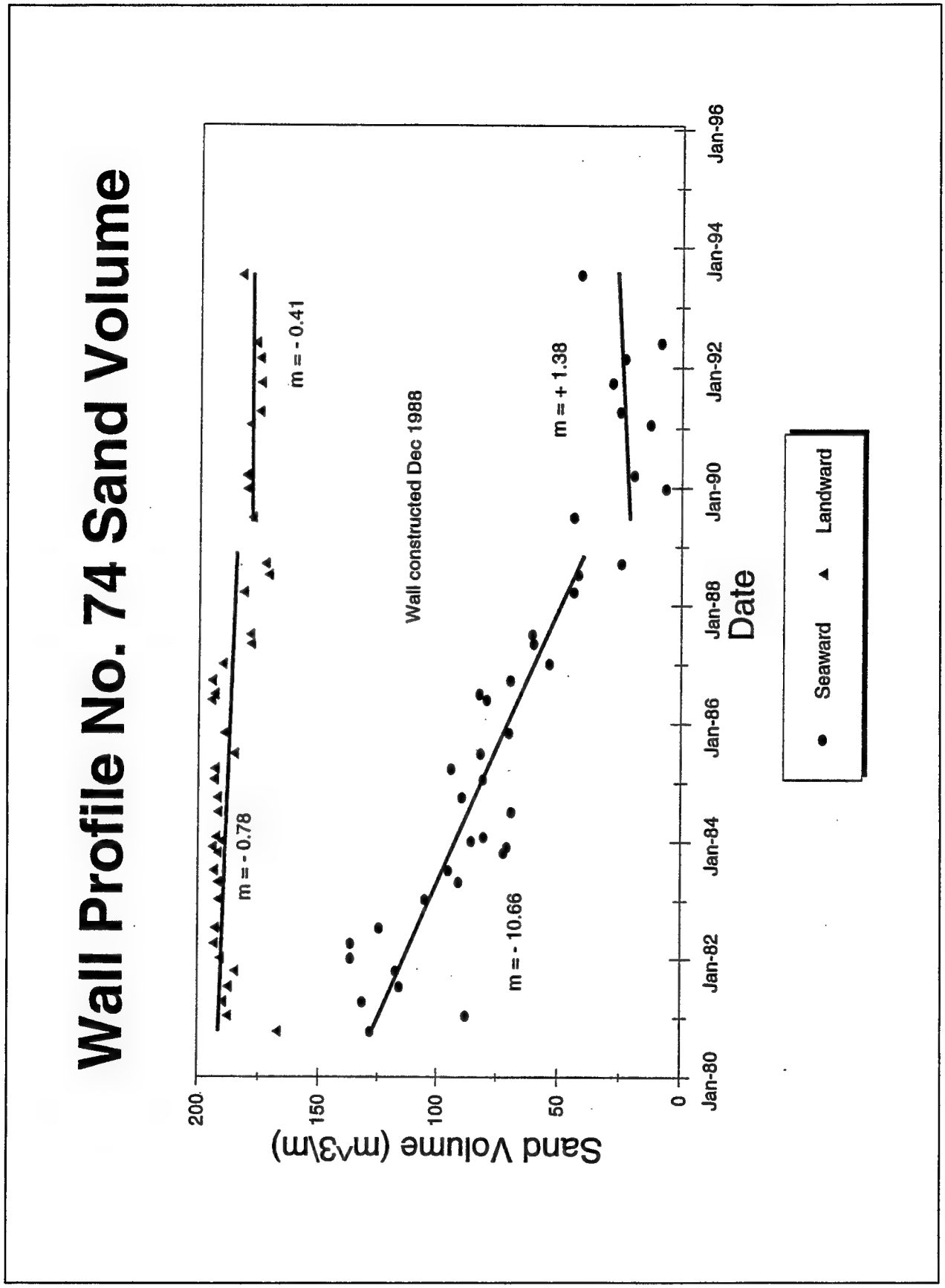

End of Wall Profile No. 46 Sand Volume
Sand Volume (m^3/m)
160
140
120
100
80
60
40
20
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Date
m = + 1.24
m = + 0.44
Seaward
Landward

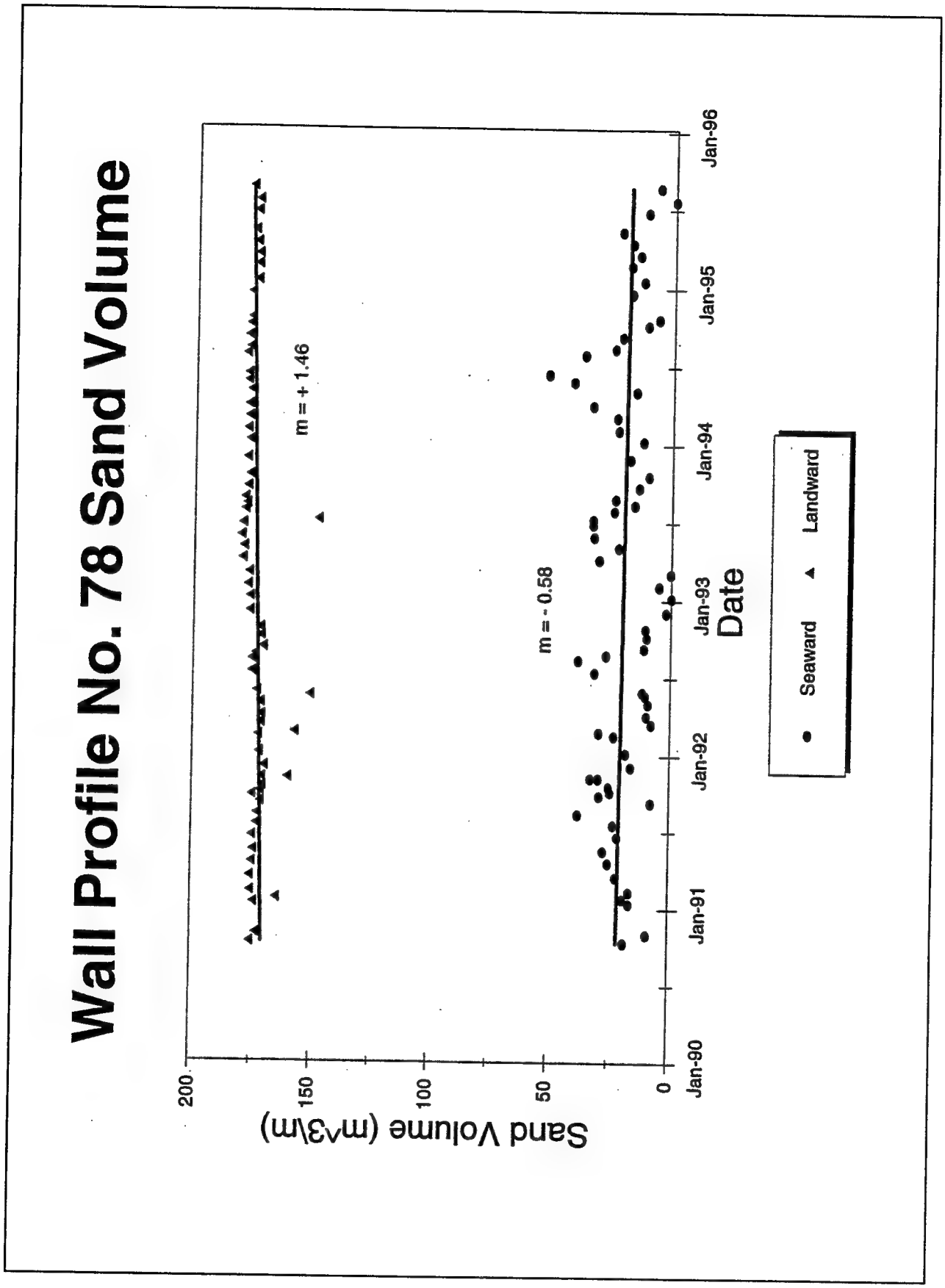

Non-Wall Profile No. 47 Sand Volume
Sand Volume (m^3\m)
200
150
100
50
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Date
m = - 5.39
m = + 0.51
Seaward
Landward

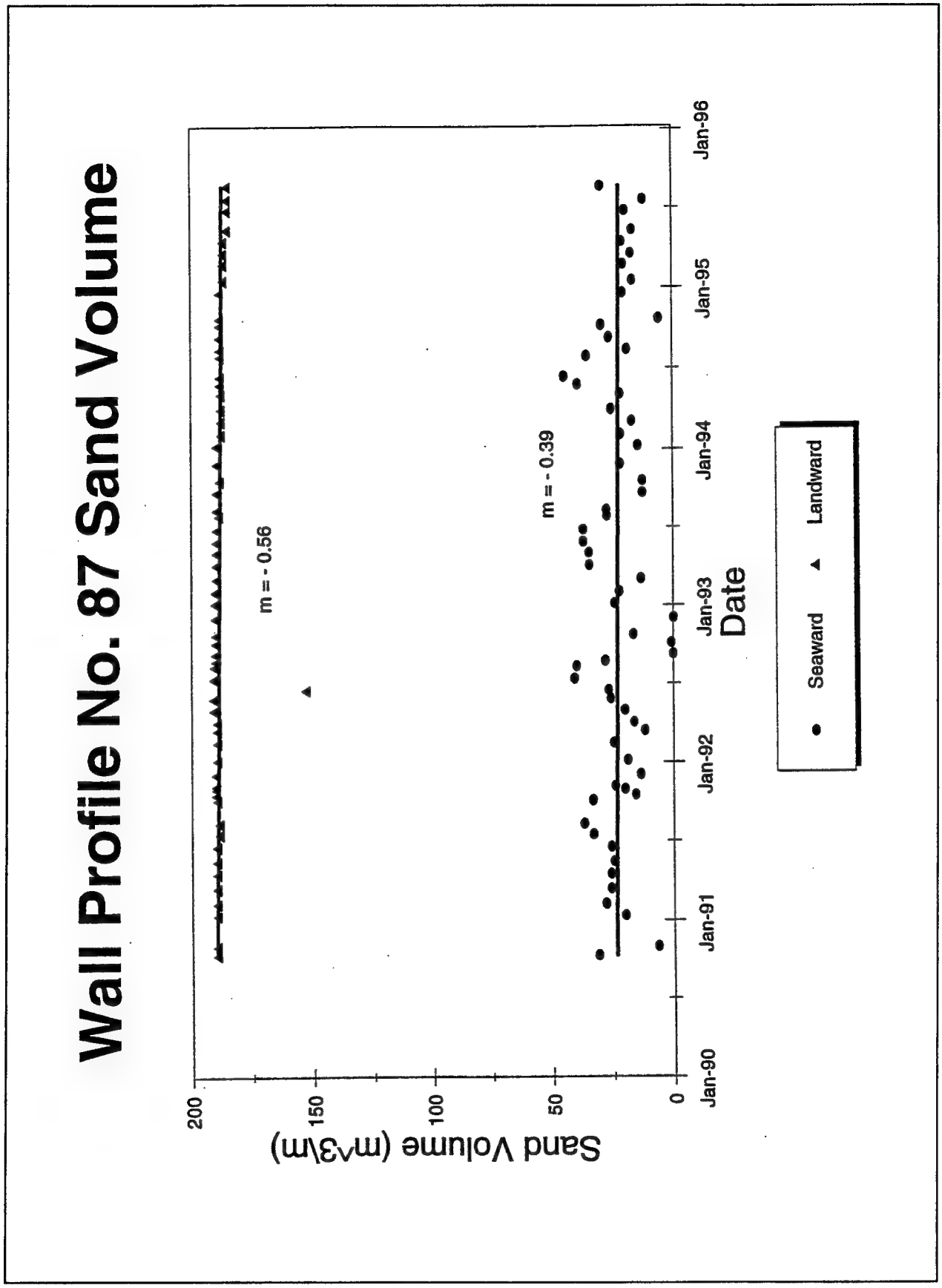

Non-Wall Profile No. 54 Sand Volume
Sand Volume (m^3/m)
160
140
120
100
80
60
40
20
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Date
m = - 4.49
m = - 1.38
Seaward
Landward

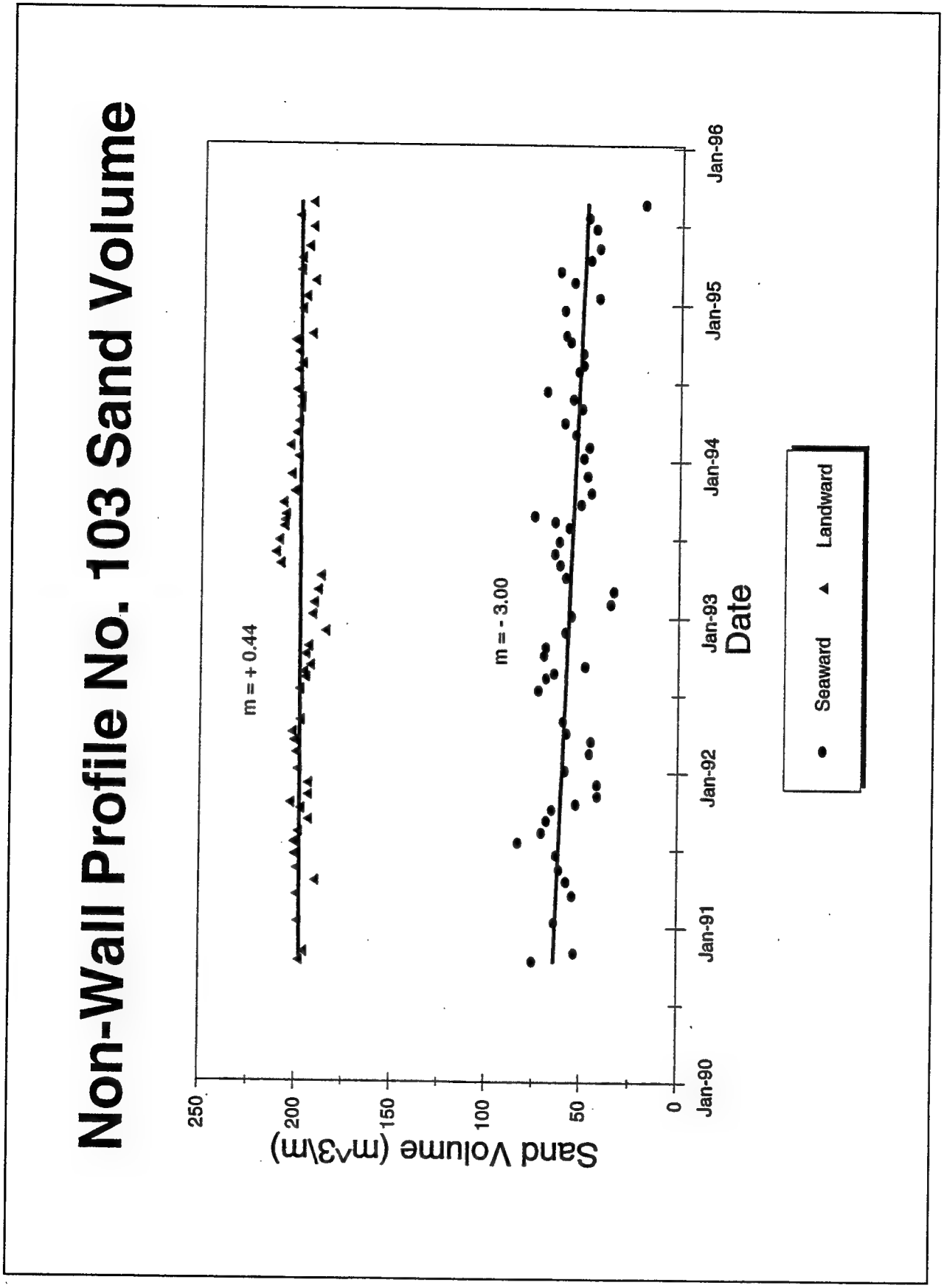

Non-Wall Profile No. 60 Sand Volume
Sand Volume (m^3\m)
250
200
150
100
50
0
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Date
m = - 5.04
m = - 6.26
No Surveys Taken
m = - 5.66
m = - 0.82
Seaward
Landward

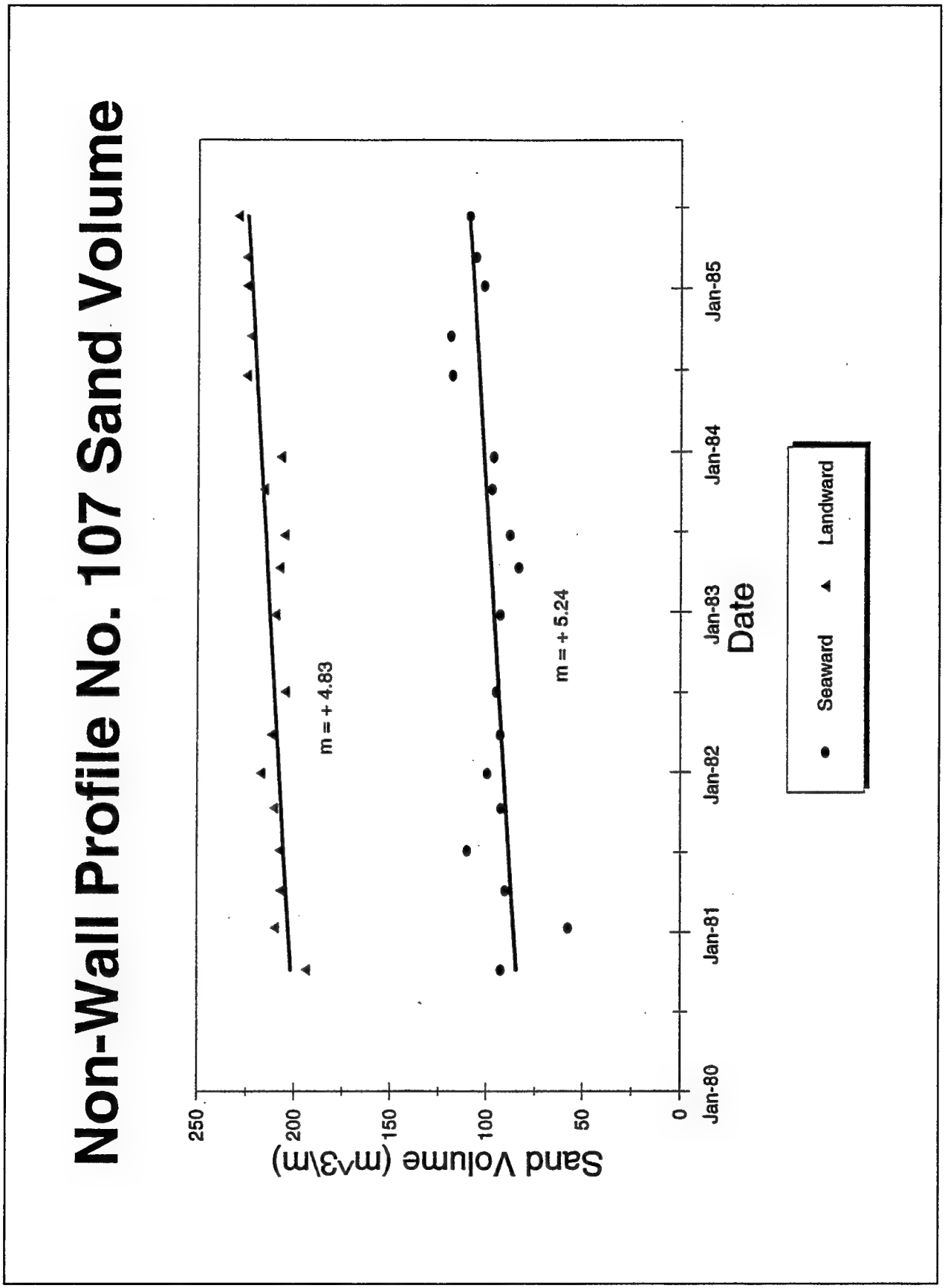

Wall Profile No. 70 Sand Volume
Sand Volume (m^3\m)
200
150
100
50
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Date
m = - 1.06
m = - 0.02
Seaward
Landward

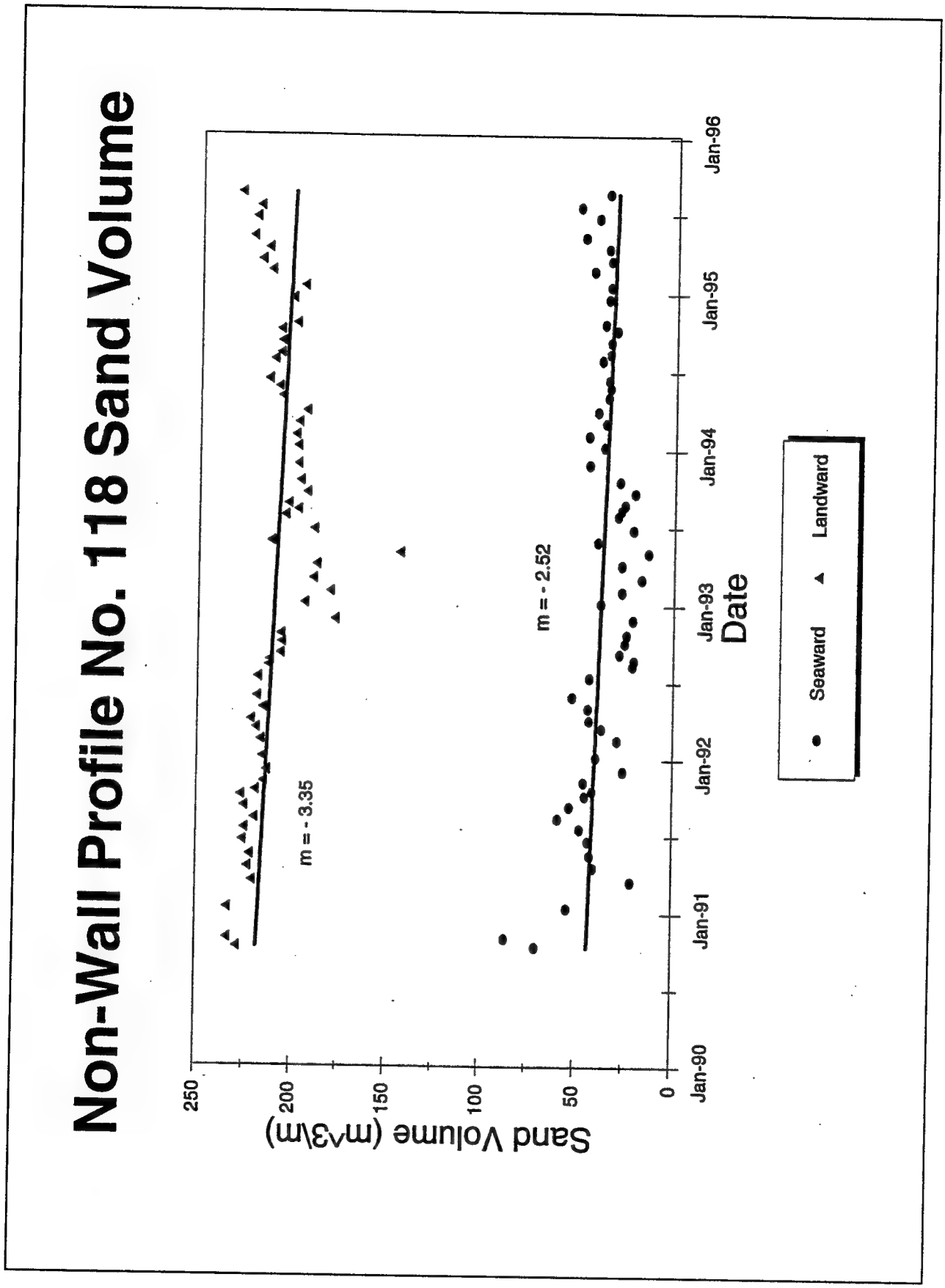

Wall Profile No. 74 Sand Volume
Sand Volume (m^3/m)
200
150
100
50
0
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Date
Wall constructed Dec 1988
m = - 0.78
m = - 0.41
m = - 10.66
m = + 1.38
Seaward
Landward

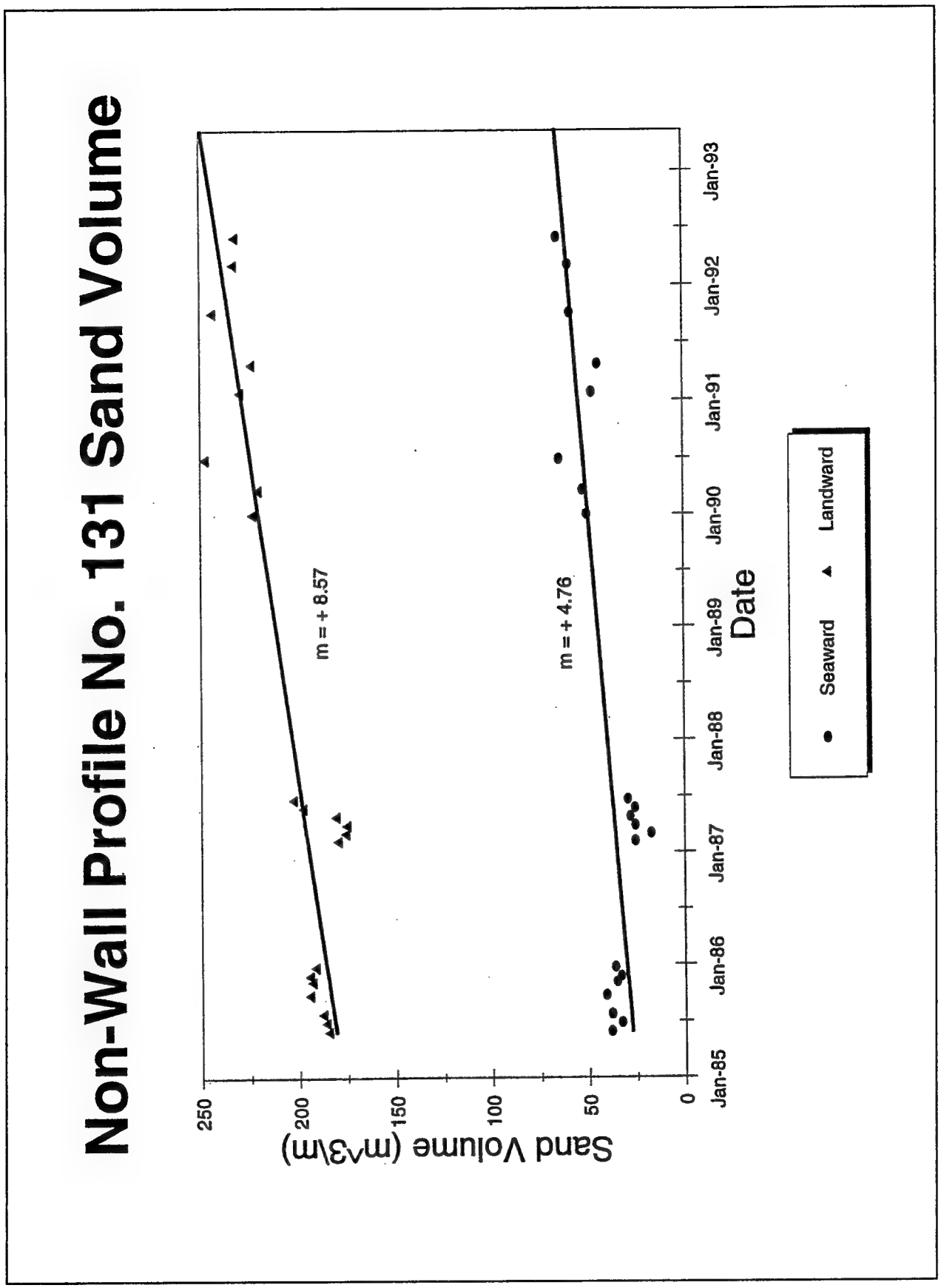

Wall Profile No. 78 Sand Volume
Sand Volume (m^3\m)
200
150
100
50
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Date
m = + 1.46
m = - 0.58
Seaward
Landward

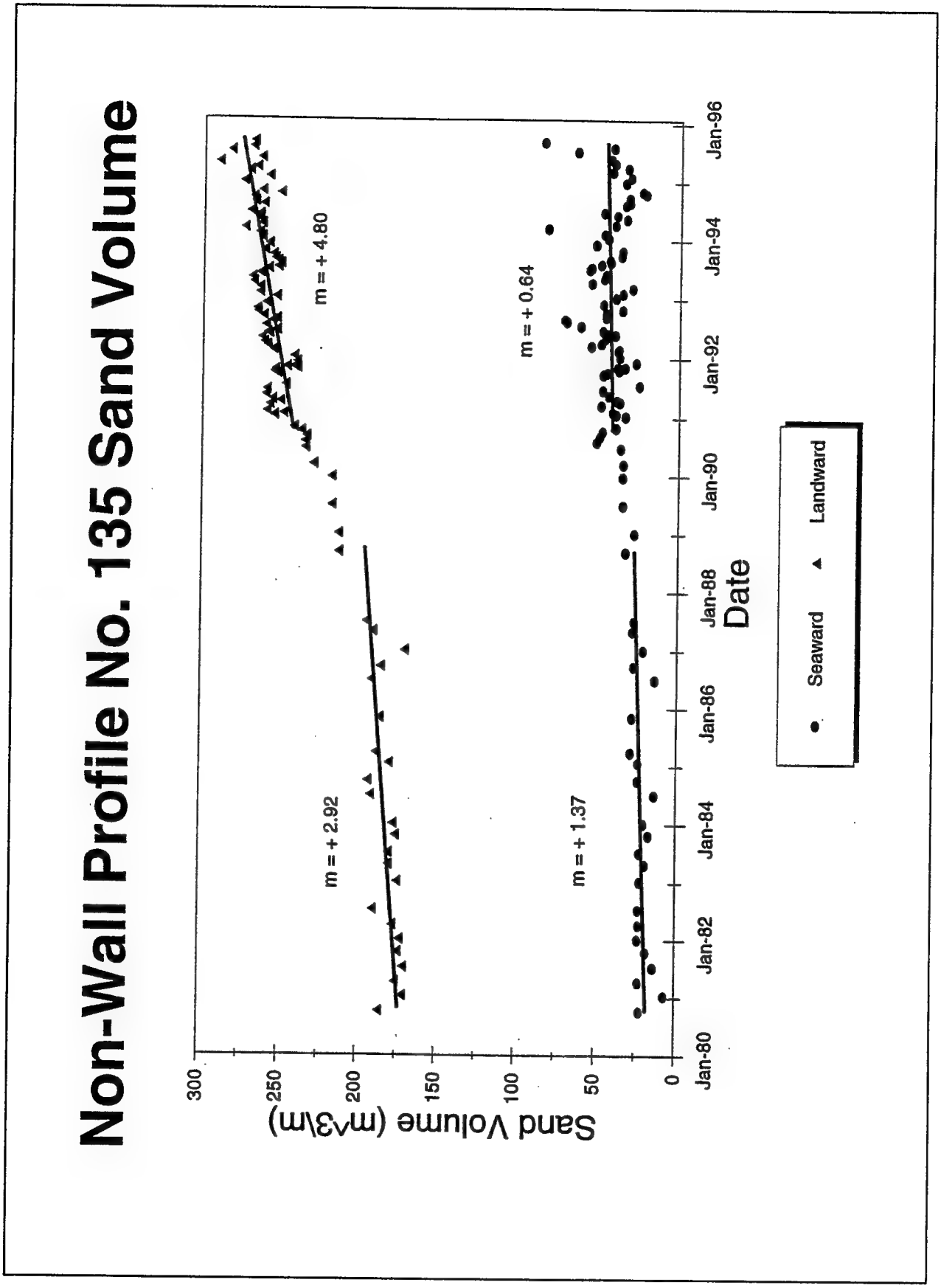

Wall Profile No. 87 Sand Volume
Sand Volume (m^3\m)
200
150
100
50
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Date
m = - 0.56
m = - 0.39
Seaward
Landward

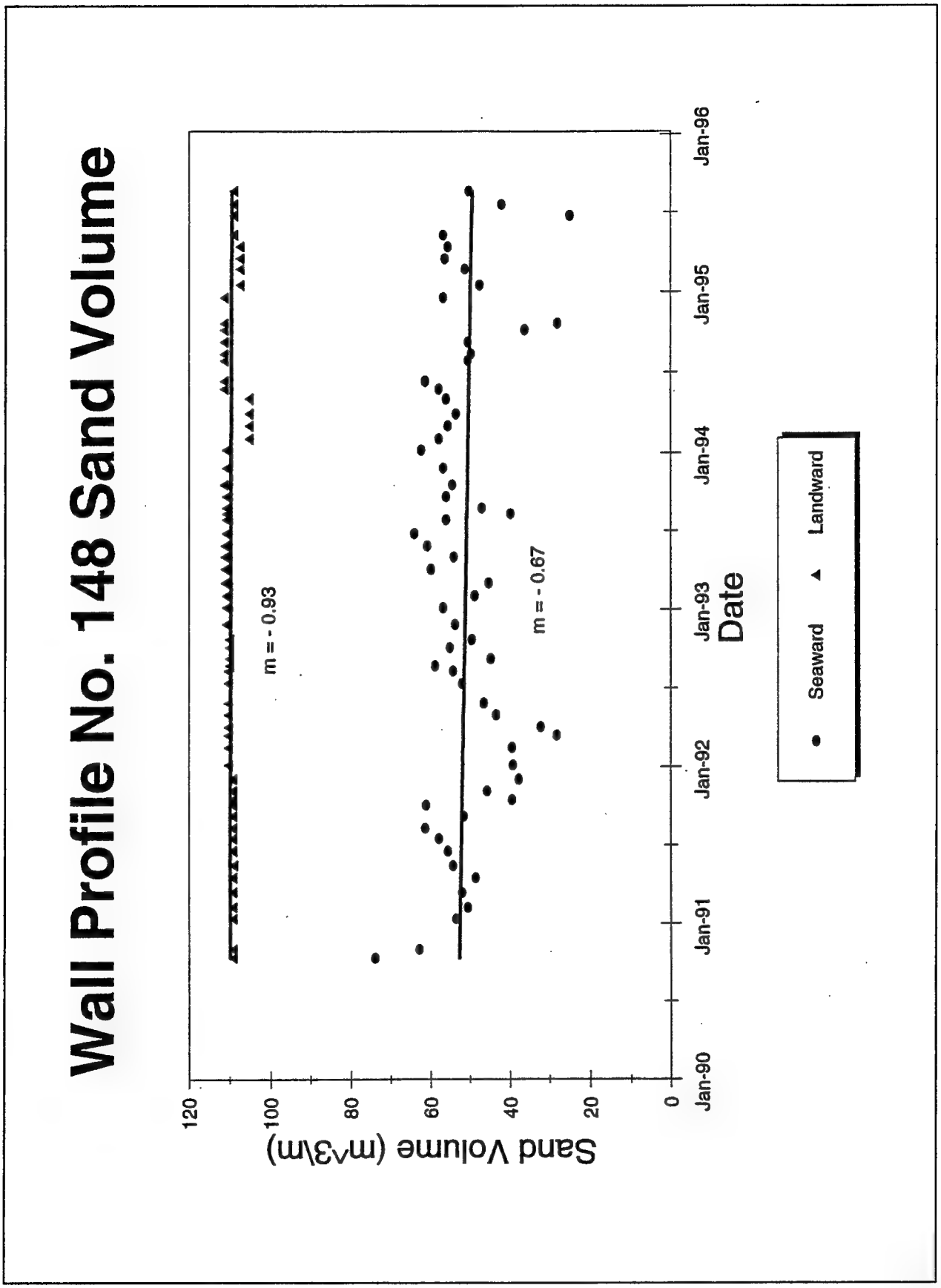

Non-Wall Profile No. 103 Sand Volume
Sand Volume (m^3\m)
250
200
150
100
50
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Date
m = + 0.44
m = - 3.00
Seaward
Landward


Non-Wall Profile No. 107 Sand Volume
Sand Volume (m^3\m)
250
200
150
100
50
0
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Date
m = + 4.83
m = + 5.24
Seaward
Landward

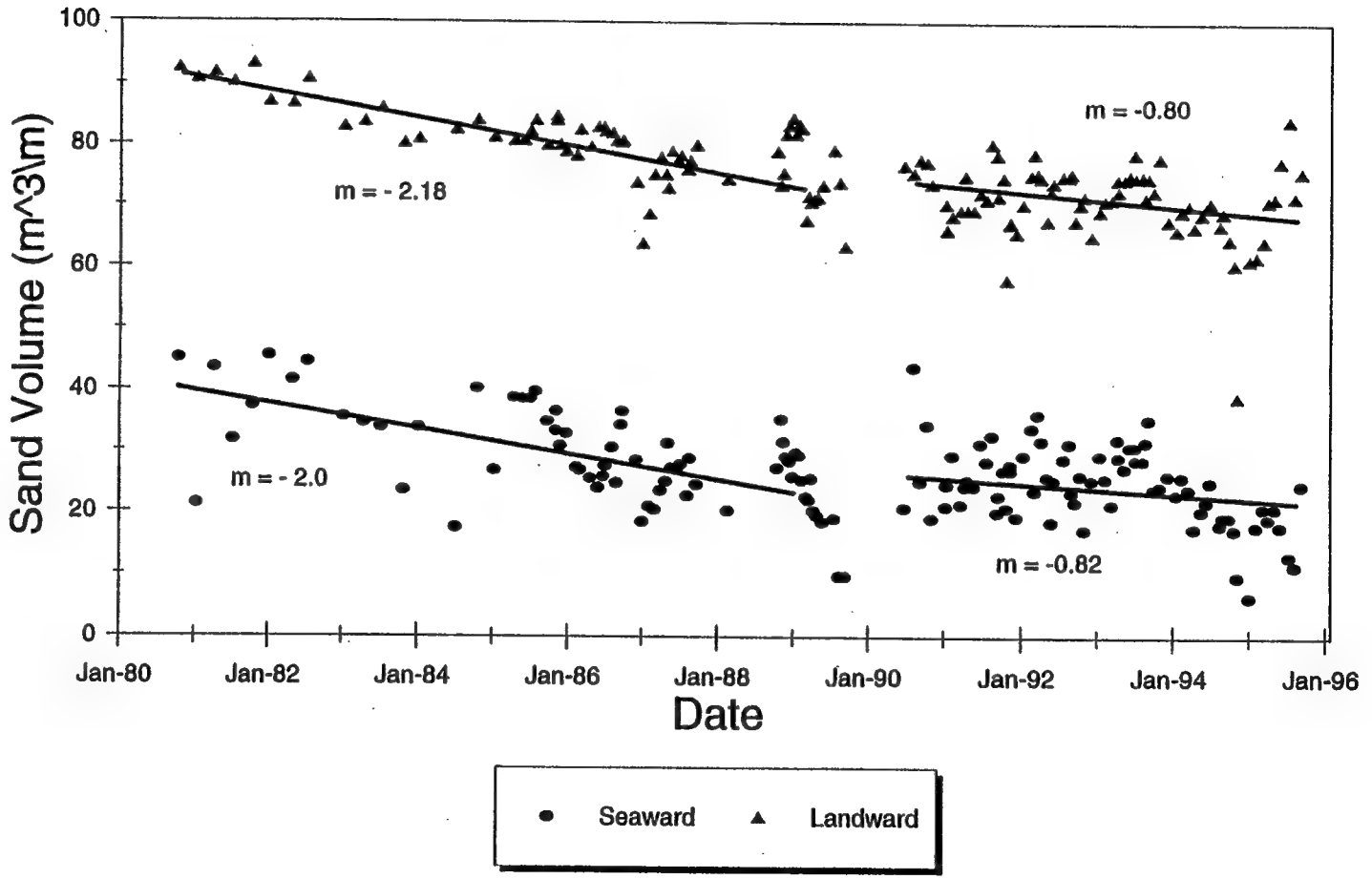

Non-Wall Profile No. 118 Sand Volume
Sand Volume (m^3\m)
250
200
150
100
50
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Date
m = - 3.35
m = - 2.52
Seaward
Landward

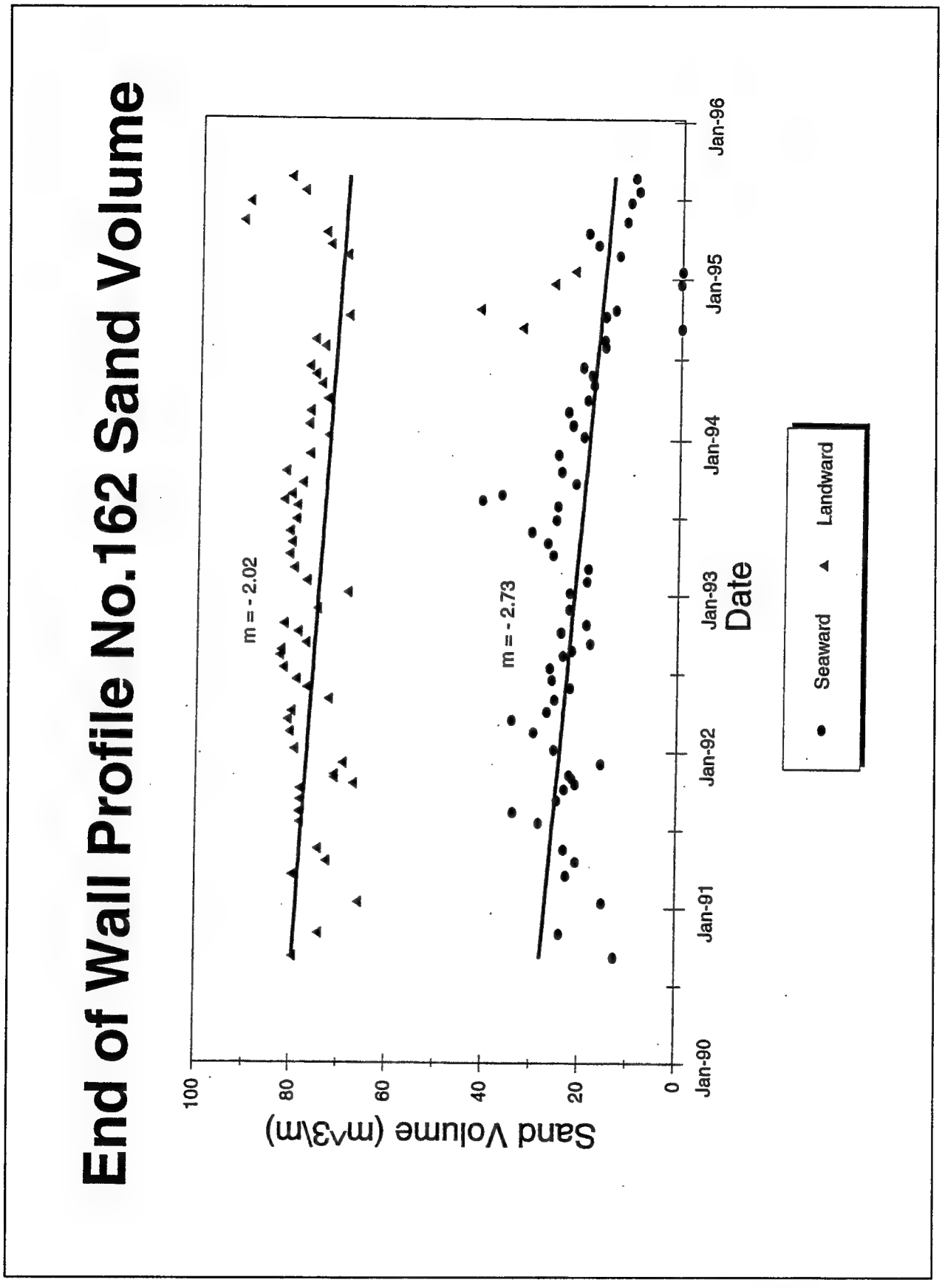

Non-Wall Profile No. 131 Sand Volume
Sand Volume (m^3/m)
250
200
150
100
50
0
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Date
m = + 8.57
m = + 4.76
Seaward
Landward

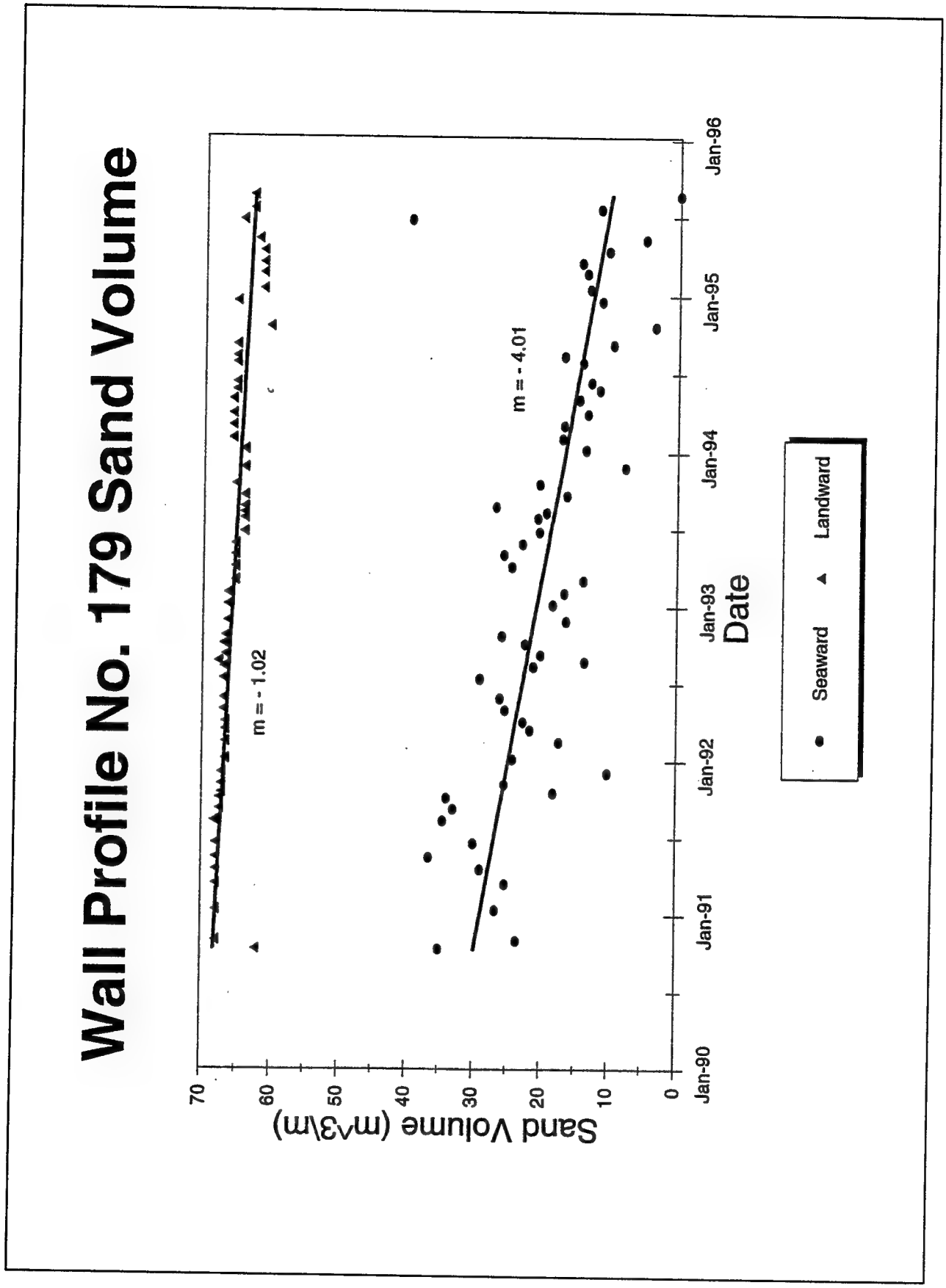

Non-Wall Profile No. 135 Sand Volume
Sand Volume (m^3\m)
300
250
200
150
100
50
0
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Date
m = + 2.92
m = + 4.80
m = + 1.37
m = + 0.64
Seaward
Landward

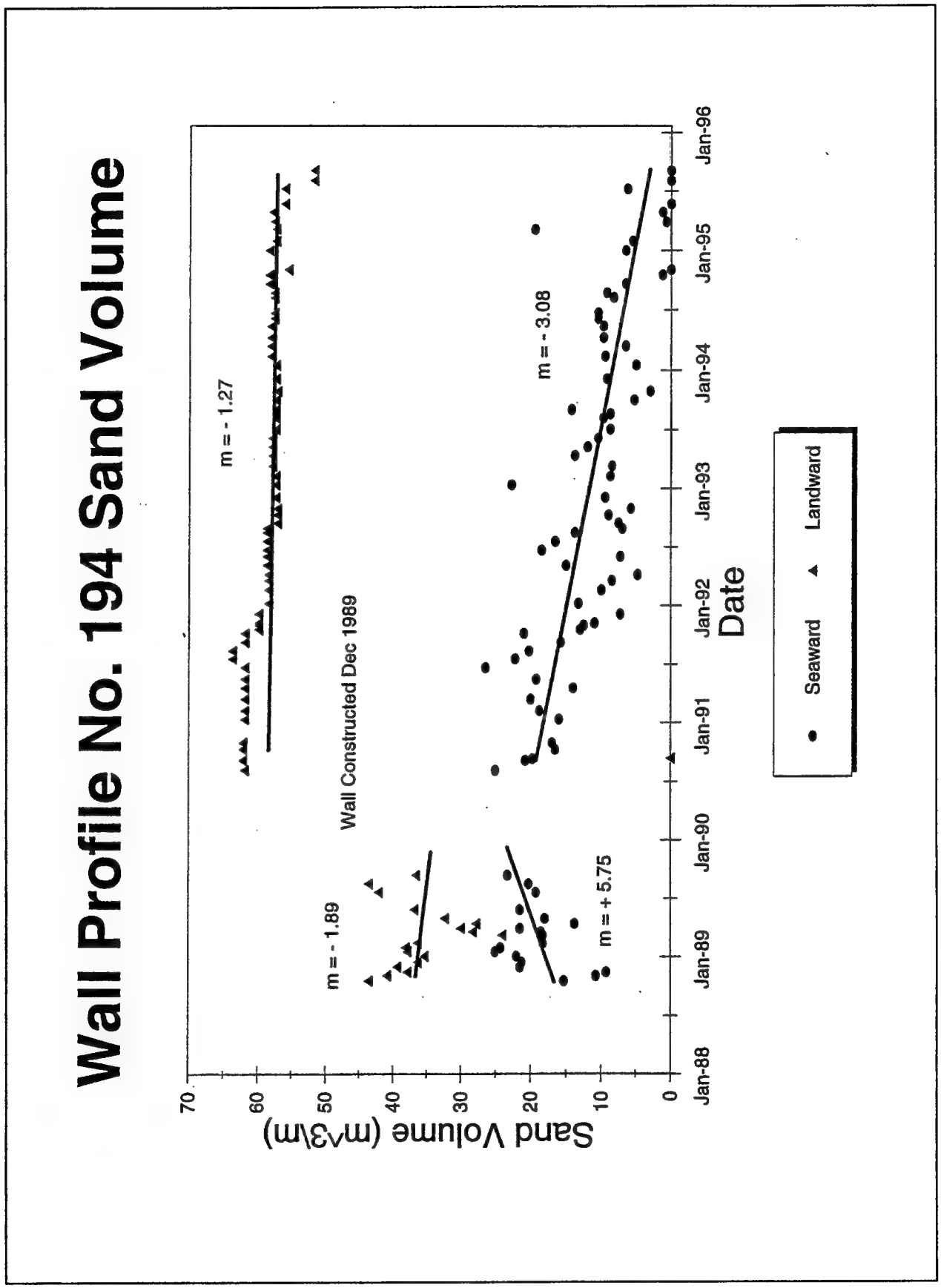

Wall Profile No. 148 Sand Volume
Sand Volume (m^3\m)
120
100
80
60
40
20
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Date
m = - 0.93
m = - 0.67
Seaward
Landward

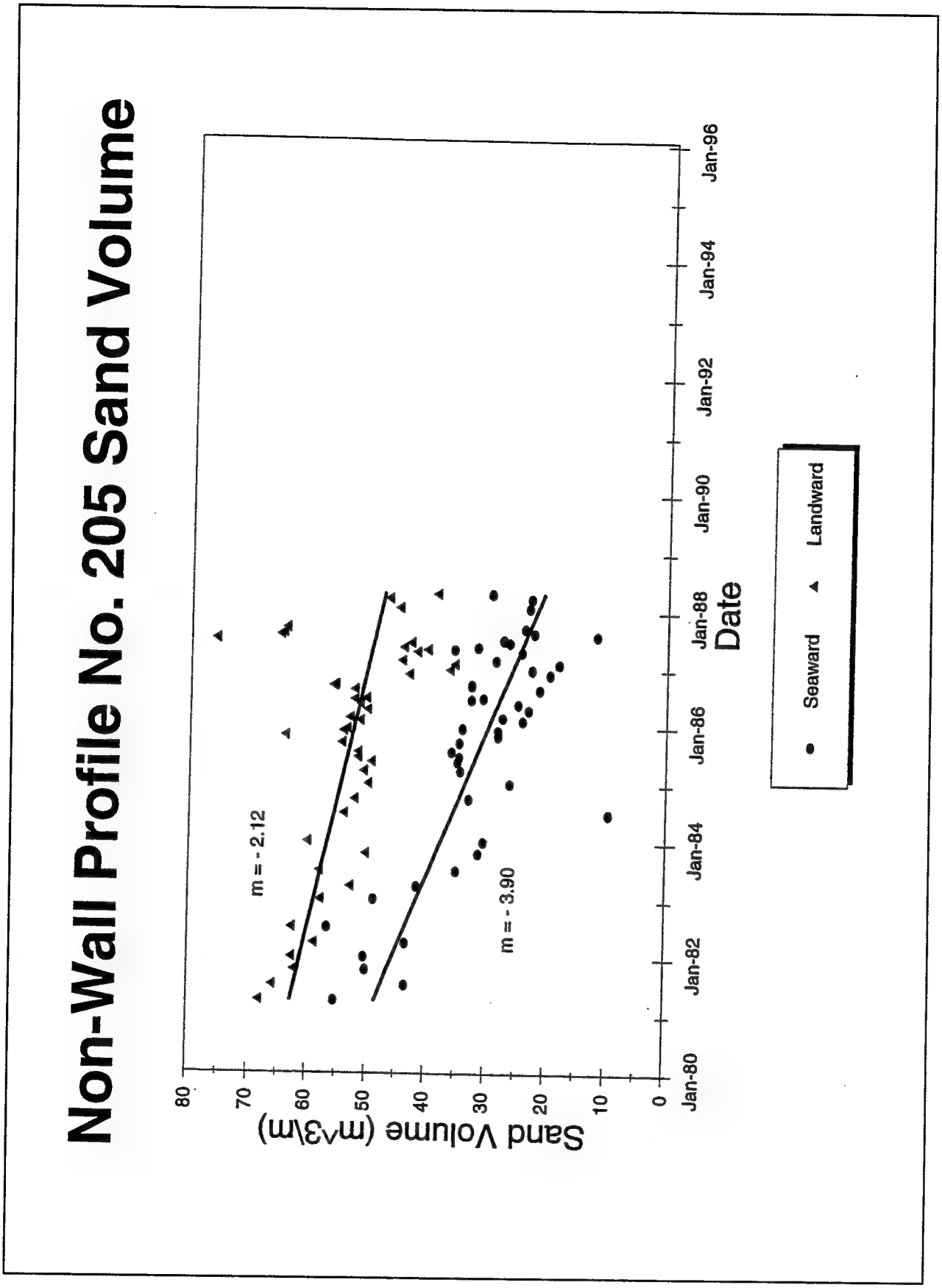
Non-Wall Profile No. 161 Sand Volume

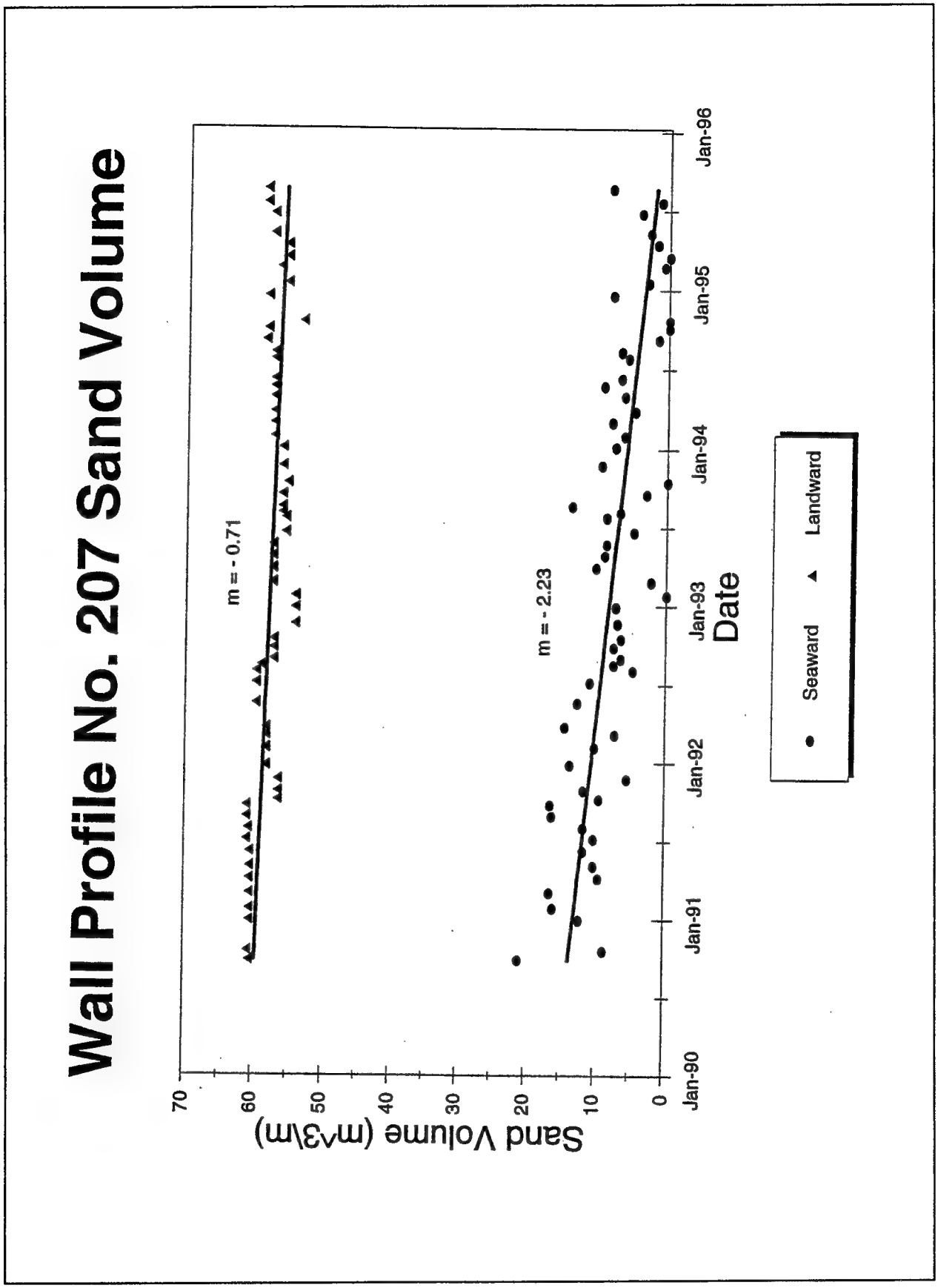


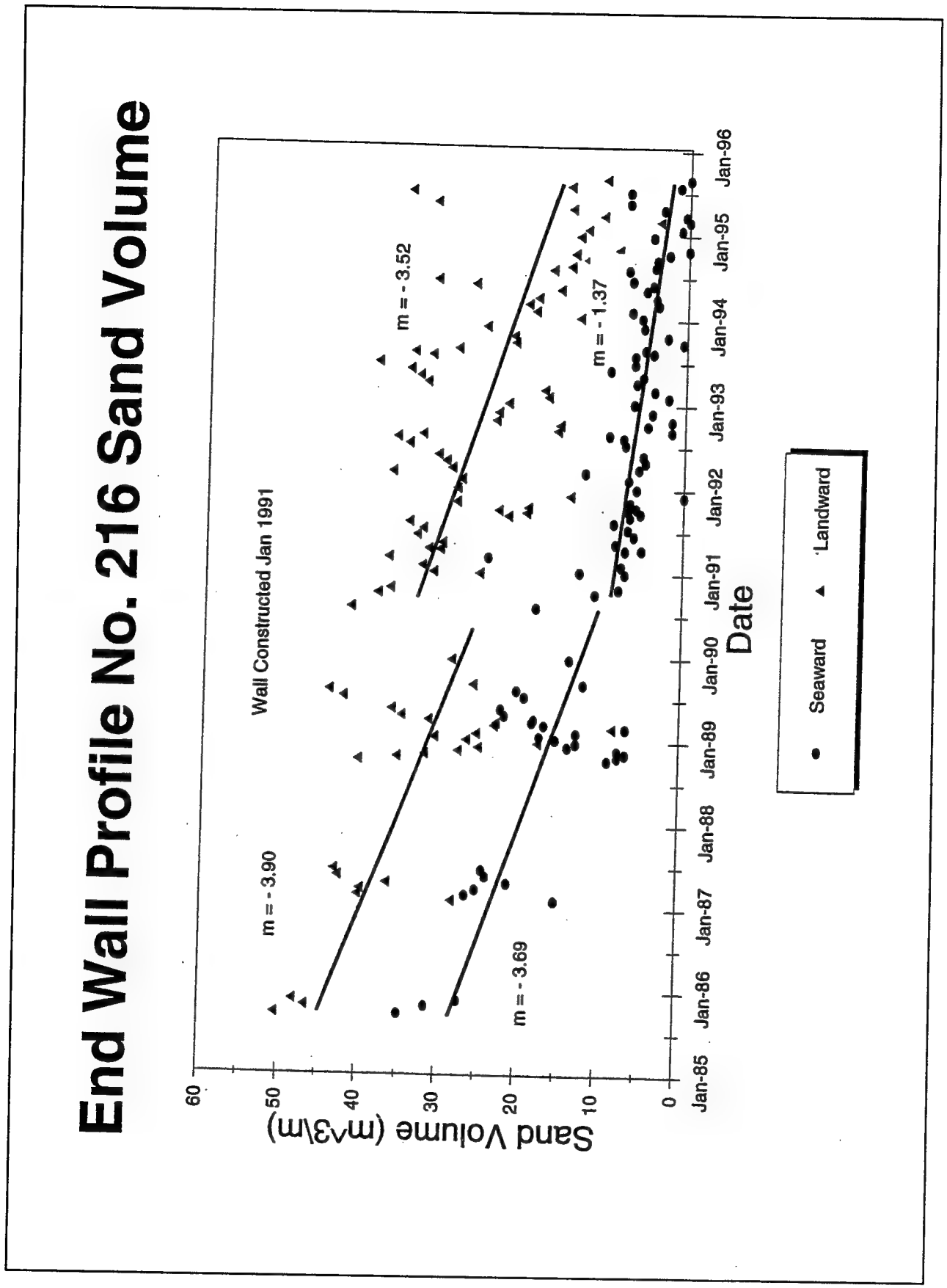

End of Wall Profile No.162 Sand Volume
Sand Volume (m^3\m)
100
80
60
40
20
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Date
m = - 2.02
m = - 2.73
Seaward
Landward

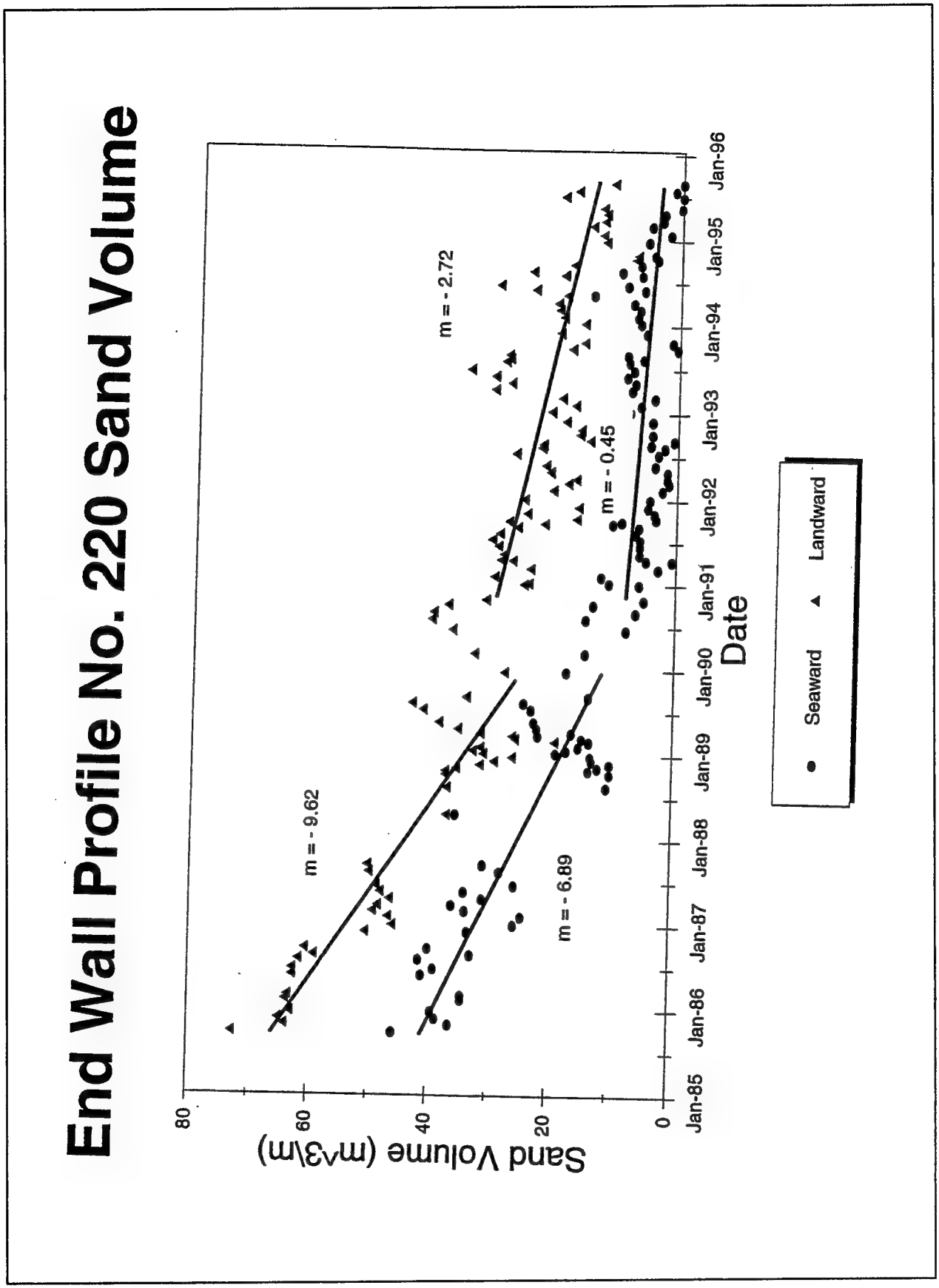

Wall Profile No. 179 Sand Volume
Sand Volume (m^3\m)
70
60
50
40
30
20
10
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Date
m = - 1.02
m = - 4.01
Seaward
Landward

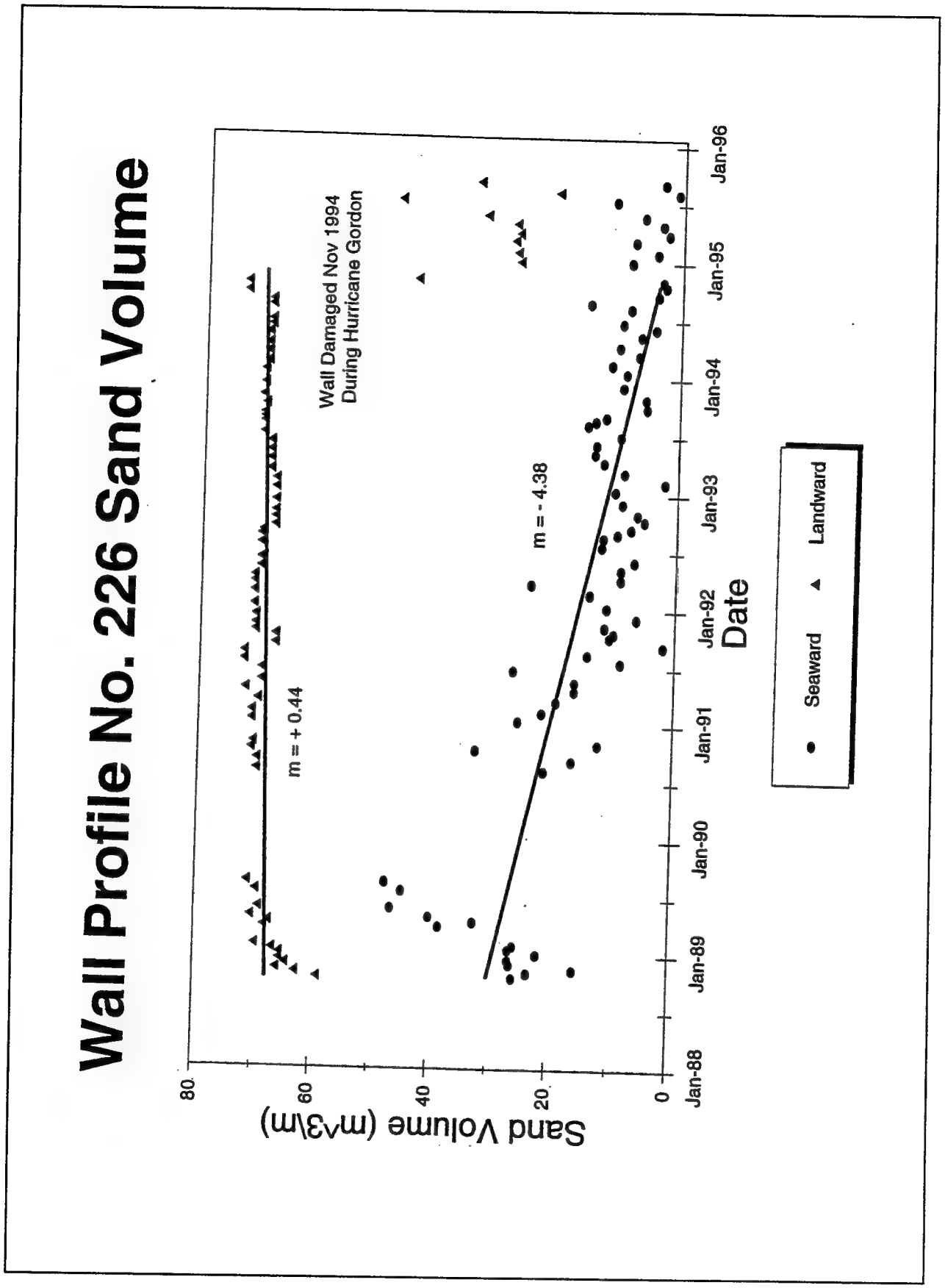

Wall Profile No. 194 Sand Volume
Sand Volume (m^3\m)
70
60
50
40
30
20
10
0
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Date
m = - 1.27
m = - 1.89
Wall Constructed Dec 1989
m = + 5.75
m = - 3.08
Seaward
Landward

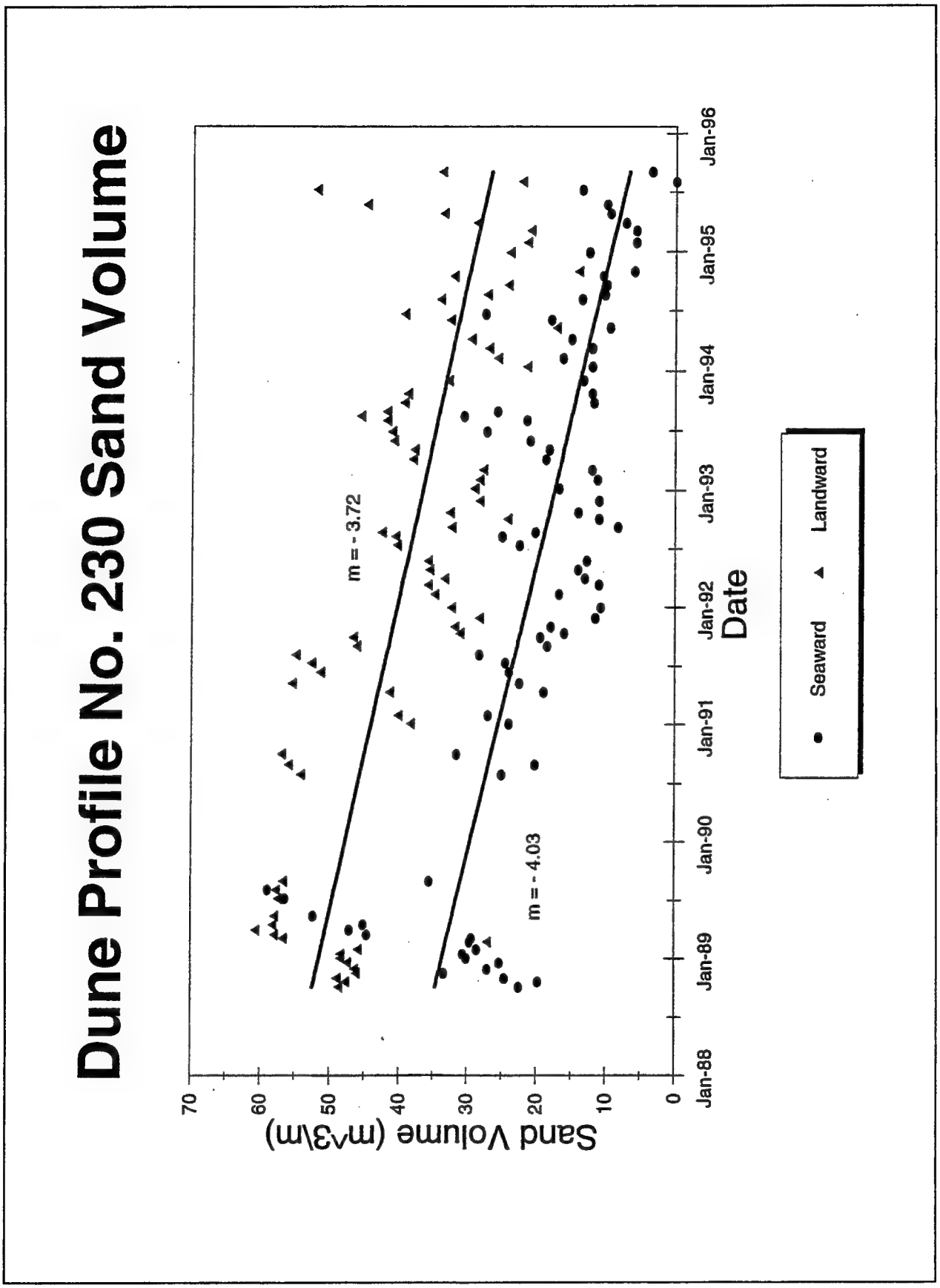

Non-Wall Profile No. 205 Sand Volume
Sand Volume (m^3\m)
80
70
60
50
40
30
20
10
0
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Date
m = - 2.12
m = - 3.90
Seaward
Landward

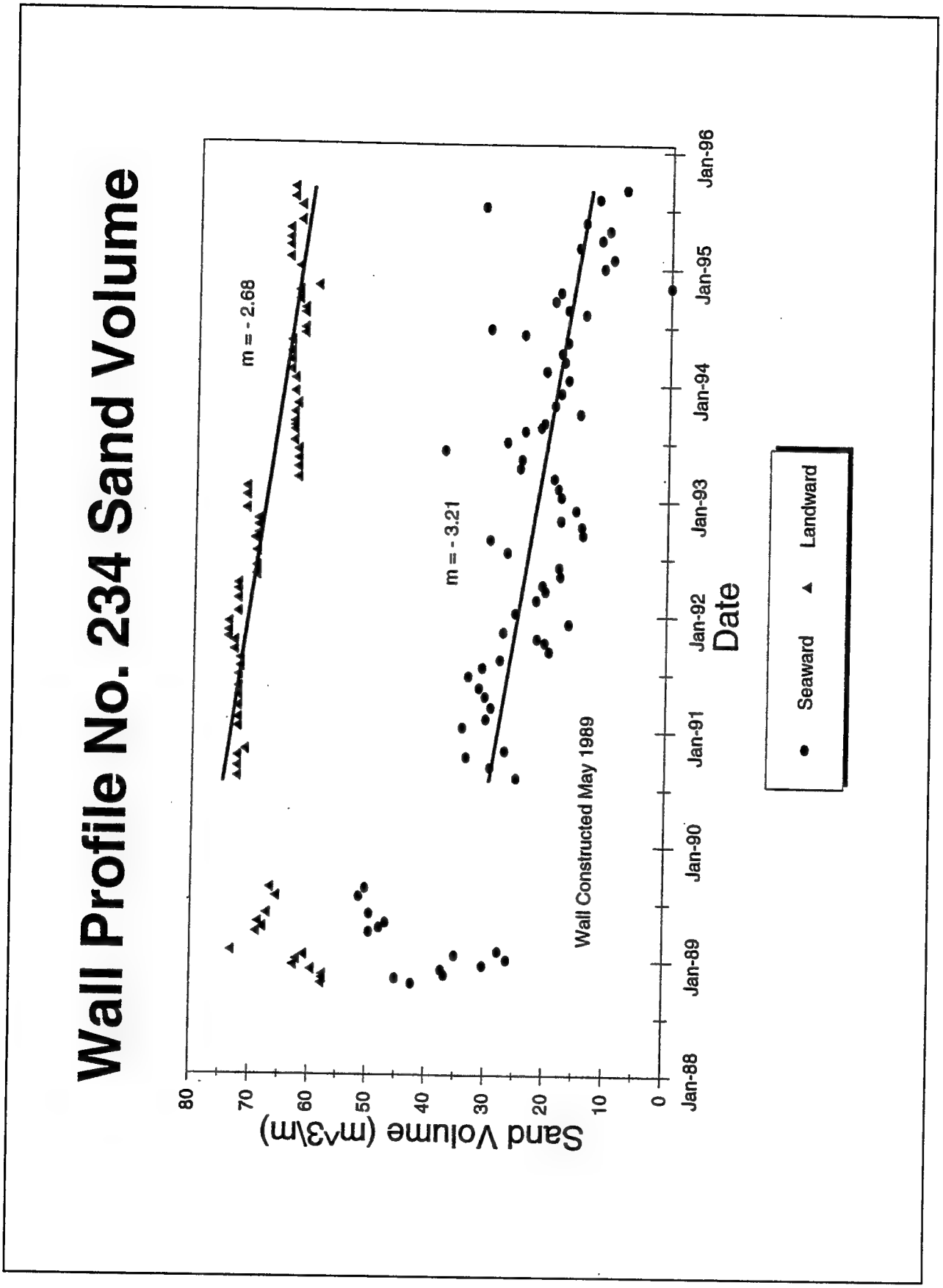

Wall Profile No. 207 Sand Volume
Sand Volume (m^3\m)
70
60
50
40
30
20
10
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Date
m = - 0.71
m = - 2.23
Seaward
Landward

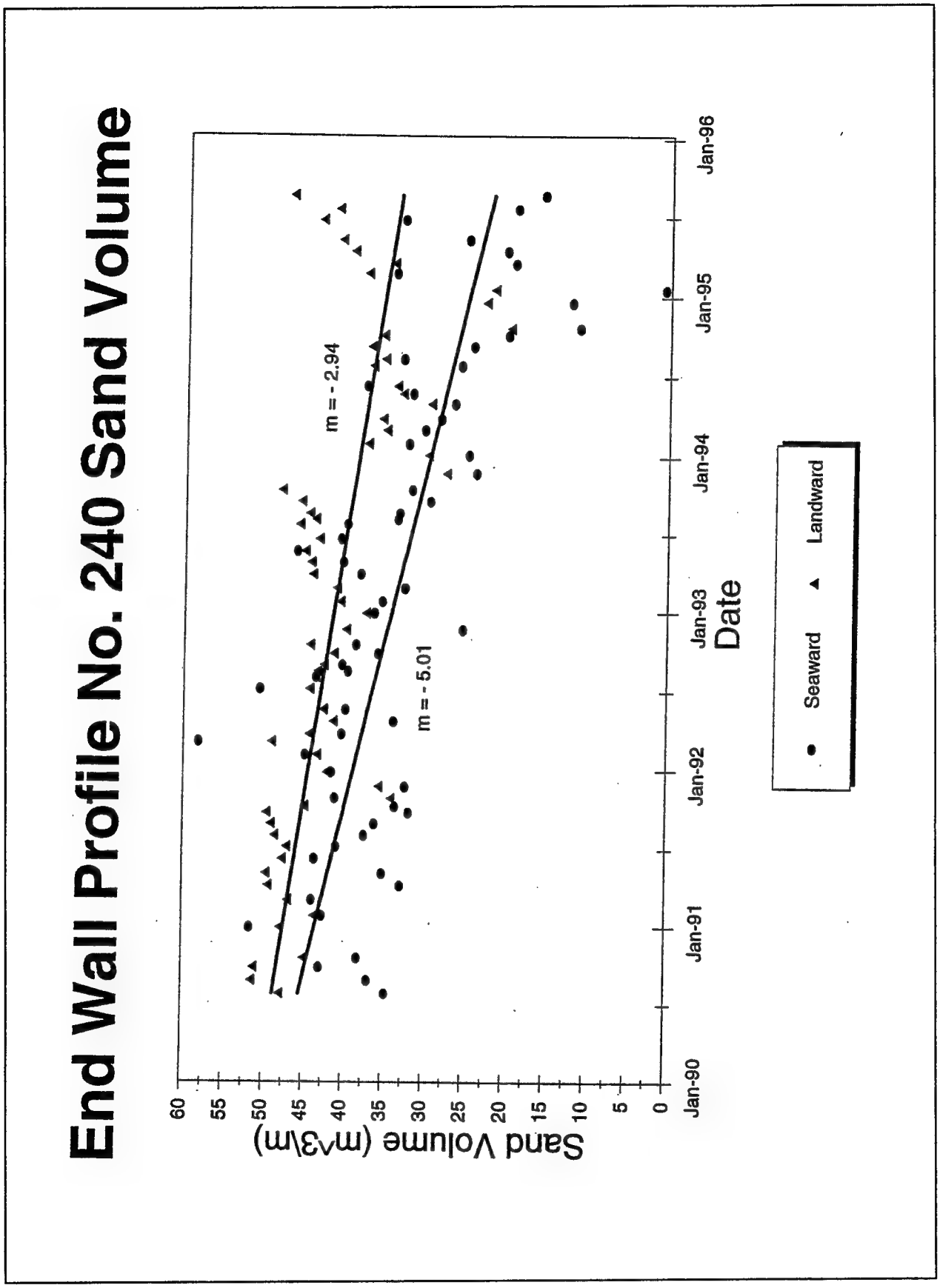

End Wall Profile No. 216 Sand Volume
Wall Constructed Jan 1991
m = - 3.90
m = - 3.69
m = - 3.52
m = - 1.37
Sand Volume (m^3\m)
0
10
20
30
40
50
60
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Date
Seaward
Landward

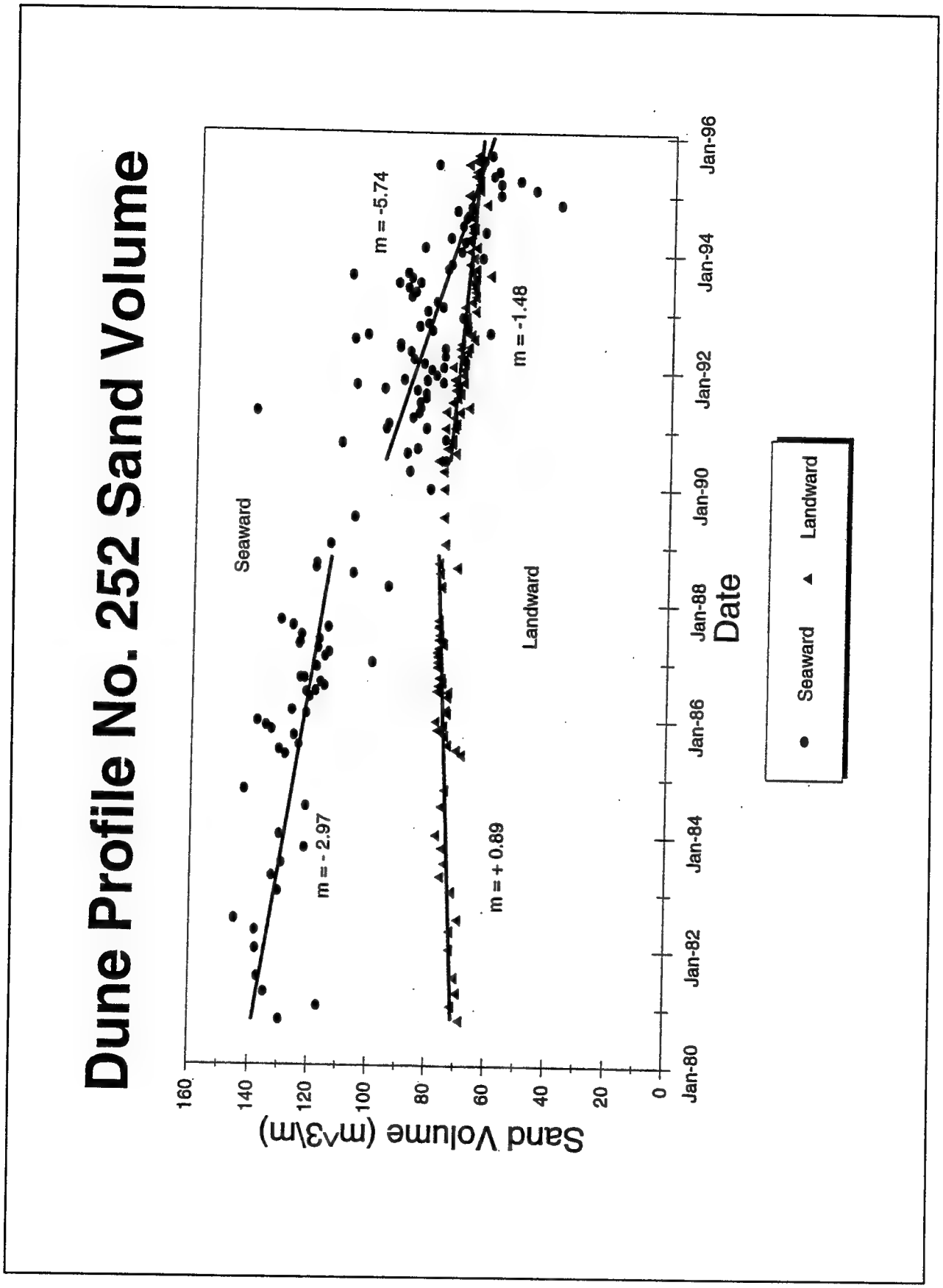

End Wall Profile No. 220 Sand Volume
Sand Volume (m^3\m)
0
20
40
60
80
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Date
m = - 9.62
m = - 6.89
m = - 2.72
m = - 0.45
Seaward
Landward


Wall Profile No. 226 Sand Volume
Wall Damaged Nov 1994
During Hurricane Gordon
m = + 0.44
m = - 4.38
Sand Volume (m^3\m)
80
60
40
20
0
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Date
Seaward
Landward


Dune Profile No. 230 Sand Volume
Sand Volume (m^3\m)
70
60
50
40
30
20
10
0
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Date
m = - 3.72
m = - 4.03
Seaward
Landward


Wall Profile No. 234 Sand Volume
Sand Volume (m^3\m)
80
70
60
50
40
30
20
10
0
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Date
m = - 2.68
m = - 3.21
Wall Constructed May 1989
Seaward
Landward


End Wall Profile No. 240 Sand Volume
Sand Volume (m^3\m)
60
55
50
45
40
35
30
25
20
15
10
5
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Date
m = - 2.94
m = - 5.01
Seaward
Landward


Dune Profile No. 252 Sand Volume
Sand Volume (m^3\m)
160
140
120
100
80
60
40
20
0
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Date
Seaward
Landward
m = - 2.97
m = + 0.89
m = -5.74
m = -1.48
Seaward
Landward

Appendix D
Beach Profile Parameter Data Set

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
10/09/80	1	65980	1190	253.1	60.7	192.4	2.3	75.1
01/15/81	1	66078	1250	276.9	47.7	229.3	2.4	72.6
04/12/81	1	66165	1310	275.9	48.4	227.5	2.4	75.5
10/25/81	1	66361	1440	284.0	57.7	226.0	2.3	76.0
01/09/82	1	66437	1490	291.2	67.2	224.0	2.4	80.1
04/09/82	1	66527	1550	286.0	57.7	228.3	2.5	74.3
07/16/82	1	66625	1610	283.2	56.2	226.8	2.5	72.8
01/09/83	1	66802	1730	271.4	53.7	217.7	2.2	76.5
04/28/83	1	66911	1800	286.7	65.0	221.7	2.2	78.8
07/12/83	1	66986	1850	281.7	59.7	222.0	2.2	75.3
10/27/83	1	67093	1920	255.4	35.1	220.2	1.6	66.9
01/11/84	1	67169	1970	280.7	58.7	222.0	1.7	78.1
07/10/84	1	67350	2090	251.6	26.8	224.8	1.5	61.1
10/09/84	1	67441	2150	270.4	44.9	225.3	1.9	72.9
01/29/85	1	67553	2220	274.2	47.7	226.8	1.9	76.4
04/20/85	1	67634	2280	282.2	54.7	227.5	2.1	79.9
11/12/85	1	67840	2410	258.6	38.4	220.2	1.7	67.8
07/09/86	1	68079	2570	267.4	46.2	221.2	1.9	71.6
09/29/86	1	68161	2630	275.2	51.9	223.2	2.0	74.4
01/09/87	1	68263	2690	250.6	35.1	215.5	1.3	65.4
05/12/87	1	68386	2770	279.7	58.7	221.0	2.1	78.5
07/09/87	1	68444	2810	295.0	67.0	228.0	2.3	78.1
03/31/88	1	68710	2980	281.4	54.4	227.0	2.4	75.8
07/17/88	1	68818	3060	294.5	60.7	233.8	2.8	76.7
01/12/89	1	68997	3170	291.2	57.4	233.8	2.9	76.0
07/11/89	1	69177	3290	299.8	68.0	231.8	2.5	78.6
01/05/90	1	69355	3410	220.5	31.1	189.4	1.0	68.9
03/28/90	1	69437	3460	241.6	35.1	206.4	1.6	66.4
07/08/90	1	69539	3530	247.6	37.9	209.7	1.9	66.8
08/14/90	1	69576	3560	264.6	49.9	215.0	2.1	67.5
09/13/90	1	69606	3580	236.3	29.3	206.9	1.9	62.6
10/18/90	1	69641	3600	252.6	38.4	214.2	1.9	67.0
11/07/90	1	69661	3610	239.8	31.6	208.4	1.8	65.7
01/19/91	1	69734	3660	225.0	28.1	196.7	1.2	67.5
01/31/91	1	69746	3660	241.1	37.1	203.9	1.5	69.9
02/15/91	1	69761	3680	244.8	38.1	206.7	1.6	68.1
04/11/91	1	69816	3710	238.5	34.6	203.9	1.6	66.0
04/27/91	1	69832	3720	242.6	42.1	200.4	1.8	69.7
05/25/91	1	69860	3740	236.0	37.9	198.2	1.8	67.1
06/29/91	1	69895	3760	267.4	51.4	216.0	2.2	70.7
07/27/91	1	69923	3780	256.6	48.4	207.9	1.9	68.5
08/22/91	1	69949	3800	261.9	53.9	207.9	2.1	73.7
09/19/91	1	69977	3820	239.1	31.9	207.2	2.0	64.6
10/15/91	1	70003	3840	233.5	26.6	206.9	1.8	61.5
10/29/91	1	70017	3851	213.0	20.3	192.6	1.4	61.2
11/11/91	1	70030	3852	213.5	36.1	177.3	1.0	73.2
11/17/91	1	70036	3860	246.3	49.4	196.7	1.3	76.0
11/18/91	1	70037	3860	243.1	49.9	193.1	1.4	75.7
12/15/91	1	70064	3880	219.2	28.3	191.1	1.6	62.0
01/17/92	1	70097	3900	223.2	42.9	180.4	1.5	72.1
02/27/92	1	70138	3920	220.5	31.9	188.6	1.3	69.1
03/12/92	1	70152	3930	246.6	45.4	201.2	1.7	73.3
03/28/92	1	70168	3940	223.0	28.1	194.7	1.6	65.4
04/15/92	1	70186	3960	236.3	39.4	197.2	2.0	67.8
05/14/92	1	70215	3970	207.2	26.1	181.1	1.1	64.7
06/03/92	1	70235	3990	245.8	42.9	202.9	1.7	68.6
06/10/92	1	70242	3990	215.7	28.6	187.1	1.6	63.1
06/30/92	1	70262	4010	246.3	42.9	203.7	2.1	70.4
07/28/92	1	70290	4020	240.3	43.6	196.7	2.0	68.9
08/25/92	1	70318	4042	237.8	40.9	196.9	2.1	68.2
09/07/92	1	70331	4050	232.8	35.1	197.7	2.1	65.5
09/23/92	1	70347	4060	205.7	26.6	179.4	1.0	67.6
10/19/92	1	70373	4080	209.5	25.3	184.1	1.4	60.3
11/08/92	1	70393	4090	217.7	29.1	188.9	1.6	62.4
12/13/92	1	70428	4120	187.9	28.1	159.8	0.7	60.9
01/21/93	1	70467	4140	192.1	30.9	161.3	1.1	65.3
02/17/93	1	70494	4160	190.9	25.1	165.8	1.3	62.8

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
03/20/93	1	70525	4180	205.4	21.6	184.1	1.3	56.1
04/22/93	1	70558	4200	226.5	40.9	185.6	1.7	71.0
05/20/93	1	70586	4220	245.8	48.7	197.2	2.0	72.3
06/16/93	1	70613	4240	246.8	66.5	180.4	2.3	77.4
07/14/93	1	70641	4260	228.5	40.4	188.1	2.0	67.9
07/17/93	1	70644	4260	229.0	40.6	188.4	1.8	67.6
08/17/93	1	70675	4280	224.3	36.6	187.6	2.1	67.1
08/30/93	1	70688	4290	215.0	32.6	182.1	1.2	64.6
09/13/93	1	70702	4300	211.7	30.4	181.4	1.3	67.5
10/11/93	1	70730	4320	204.9	21.3	183.6	1.3	62.1
11/07/93	1	70757	4330	197.9	17.6	180.4	1.3	54.8
12/17/93	1	70797	4360	213.2	33.6	179.6	1.4	68.6
01/28/94	1	70839	4380	203.4	27.3	176.1	1.2	60.2
02/23/94	1	70865	4400	219.2	36.9	182.4	1.4	71.2
05/26/94	1	70957	4460	200.9	28.8	172.3	1.3	64.8
06/18/94	1	70980	4480	220.0	45.7	174.3	1.6	70.4
07/06/94	1	70998	4490	225.0	47.4	177.6	1.7	71.8
08/21/94	1	71044	4520	198.7	23.6	175.1	1.4	60.0
09/05/94	1	71059	4530	196.7	25.1	171.6	1.2	55.0
10/03/94	1	71087	4550	223.7	40.6	183.1	1.8	67.4
10/30/94	1	71114	4570	212.5	34.1	178.1	2.0	65.3
11/15/94	1	71130	4580	252.1	45.7	206.4	3.0	70.6
01/12/95	1	71188	4610	199.2	31.9	167.3	1.5	65.7
02/11/95	1	71218	4630	185.9	20.1	165.6	1.1	58.9
03/20/95	1	71255	4660	193.9	24.1	169.8	1.3	61.3
04/13/95	1	71279	4670	191.6	22.3	169.3	1.3	60.7
05/11/95	1	71307	4690	199.9	25.6	174.3	1.8	60.8
06/07/95	1	71334	4710	138.5	3.5	135.0	0.3	45.0
07/23/95	1	71380	4740	220.2	30.9	189.4	1.9	64.5
08/18/95	1	71406	4760	207.9	26.6	181.6	1.4	62.9
09/18/95	1	71437	4780	215.2	27.6	187.9	1.9	62.2

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
08/14/90	13	69576	3560	194.2	19.1	175.1	1.1	55.8
09/13/90	13	69606	3580	194.9	21.6	173.3	1.0	55.8
10/18/90	13	69641	3600	202.4	22.1	180.4	1.8	59.8
11/07/90	13	69661	3610	181.9	12.0	170.1	1.3	53.8
01/19/91	13	69734	3660	167.6	24.6	143.2	1.0	64.2
02/15/91	13	69761	3680	175.3	29.3	146.0	1.4	64.8
03/24/91	13	69798	3700	176.8	28.1	148.5	1.6	63.4
04/27/91	13	69832	3720	181.1	31.1	150.0	1.8	64.0
05/25/91	13	69860	3740	171.6	21.6	150.0	1.5	59.6
06/29/91	13	69895	3760	184.1	29.1	155.0	1.6	62.2
07/27/91	13	69923	3780	176.1	26.6	149.5	1.9	60.4
08/22/91	13	69949	3800	169.6	21.3	148.0	1.3	60.9
09/19/91	13	69977	3820	161.8	12.0	149.8	0.7	53.3
10/15/91	13	70003	3840	174.3	16.1	158.5	1.3	57.1
10/29/91	13	70017	3851	164.6	22.3	142.2	1.3	60.9
11/18/91	13	70037	3860	166.6	33.6	132.9	1.3	66.8
12/15/91	13	70064	3880	155.0	17.3	137.7	1.1	55.7
01/17/92	13	70097	3900	145.2	15.6	129.7	1.3	56.6
02/27/92	13	70138	3920	175.1	28.8	146.0	1.3	66.3
03/28/92	13	70168	3940	179.6	28.3	151.5	1.6	64.6
04/15/92	13	70186	3960	178.3	25.1	153.3	1.4	61.6
05/14/92	13	70215	3970	167.3	23.8	143.5	1.1	62.6
06/10/92	13	70242	3990	196.2	43.9	152.0	1.8	69.6
07/28/92	13	70290	4020	189.6	37.1	152.5	2.0	65.8
08/25/92	13	70318	4042	180.9	26.3	154.5	1.9	62.1
09/07/92	13	70331	4050	167.8	15.3	152.3	1.3	55.0
09/23/92	13	70347	4060	146.0	16.6	129.4	0.7	57.6
10/19/92	13	70373	4080	145.2	19.1	126.2	0.7	53.9
11/08/92	13	70393	4090	151.8	18.3	133.4	1.0	56.8
12/13/92	13	70428	4120	114.9	7.0	107.9	0.4	41.0
01/21/93	13	70467	4140	141.2	22.3	118.9	0.8	58.1
02/17/93	13	70494	4160	142.5	20.8	121.7	1.0	58.4
03/20/93	13	70525	4180	148.0	18.1	129.9	0.9	54.0
04/22/93	13	70558	4200	176.8	32.1	144.7	1.4	67.4
05/20/93	13	70586	4220	200.2	35.1	165.1	1.9	66.4
07/14/93	13	70641	4260	206.4	44.1	162.3	1.9	69.6
08/17/93	13	70675	4280	213.5	50.9	162.5	2.0	73.9
08/30/93	13	70688	4290	191.9	31.9	160.0	1.4	65.2
09/13/93	13	70702	4300	196.7	34.9	161.8	1.7	67.9
10/11/93	13	70730	4320	172.1	16.3	156.0	1.0	57.4
11/07/93	13	70757	4330	182.9	21.6	161.3	1.1	58.4
12/17/93	13	70797	4360	177.3	21.3	156.0	1.2	61.1
01/28/94	13	70839	4380	176.8	22.3	154.5	0.9	55.1
02/23/94	13	70865	4400	192.9	35.1	157.8	1.3	69.1
03/26/94	13	70896	4420	185.4	27.1	158.3	1.3	62.8
04/22/94	13	70923	4440	186.4	27.6	158.8	1.2	63.6
05/26/94	13	70957	4460	184.9	25.8	158.8	1.2	60.5
06/18/94	13	70980	4480	196.9	36.9	159.8	1.6	68.8
07/06/94	13	70998	4490	201.2	41.6	159.8	1.6	70.1
08/21/94	13	71044	4520	205.7	42.9	162.8	2.0	69.2
09/05/94	13	71059	4530	188.9	30.4	158.8	1.2	66.7
10/03/94	13	71087	4550	190.1	29.6	160.5	1.3	65.1
10/30/94	13	71114	4570	187.9	22.1	165.8	2.0	59.2
11/15/94	13	71130	4580	156.5	5.8	150.8	0.3	44.6
01/12/95	13	71188	4610	173.8	18.3	155.5	0.7	56.5
02/11/95	13	71218	4630	172.6	15.3	157.3	1.0	55.9
03/20/95	13	71255	4660	178.1	19.1	159.0	1.1	56.9
04/13/95	13	71279	4670	172.6	13.5	159.0	0.9	52.7
05/11/95	13	71307	4690	169.1	11.5	157.5	0.9	52.2
06/07/95	13	71334	4710	172.8	10.8	162.0	1.4	53.9
07/23/95	13	71380	4740	152.3	1.3	151.0	0.1	43.2
08/18/95	13	71406	4760	170.3	12.0	158.3	0.9	54.0
09/18/95	13	71437	4780	173.1	10.0	163.0	1.0	52.7

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
08/14/90	20	69576	3560	197.9	25.1	172.8	1.5	59.6
09/13/90	20	69606	3580	197.9	24.6	173.3	1.7	58.9
10/17/90	20	69640	3600	201.4	26.3	175.1	1.8	61.9
11/07/90	20	69661	3610	199.2	23.8	175.3	1.9	61.4
01/19/91	20	69734	3660	203.9	29.6	174.3	1.2	66.8
02/15/91	20	69761	3680	205.4	29.8	175.6	2.1	63.2
03/23/91	20	69797	3700	204.2	28.8	175.6	2.1	62.7
04/27/91	20	69832	3720	205.7	30.6	175.1	1.8	65.1
05/25/91	20	69860	3740	200.9	26.3	174.6	1.6	62.6
06/29/91	20	69895	3760	200.7	25.3	175.3	2.0	58.8
07/27/91	20	69923	3780	202.7	27.6	175.3	2.2	60.4
08/22/91	20	69949	3800	191.6	17.8	174.1	1.4	57.2
09/19/91	20	69977	3820	178.1	2.8	175.3	0.4	47.0
10/15/91	20	70003	3840	189.4	12.5	176.8	1.5	53.1
11/18/91	20	70037	3860	206.9	30.9	176.1	1.7	65.0
12/15/91	20	70064	3880	193.6	18.6	175.1	1.1	57.2
01/17/92	20	70097	3900	201.7	25.6	176.1	1.5	62.4
02/27/92	20	70138	3920	204.4	28.3	176.1	1.6	64.0
03/28/92	20	70168	3940	200.7	24.1	176.6	1.8	61.4
04/15/92	20	70186	3960	194.7	18.6	176.1	1.4	57.0
05/14/92	20	70215	3970	196.7	21.3	175.3	1.1	59.9
06/10/92	20	70242	3990	208.2	31.6	176.6	1.9	63.8
07/28/92	20	70290	4020	213.5	36.6	176.8	2.1	66.0
08/25/92	20	70318	4042	196.7	20.8	175.8	1.3	59.7
09/07/92	20	70331	4050	182.6	6.8	175.8	0.7	50.5
09/23/92	20	70347	4060	188.6	15.6	173.1	0.5	49.2
10/19/92	20	70373	4080	190.4	16.8	173.6	0.8	52.5
11/08/92	20	70393	4090	193.4	18.8	174.3	1.2	56.0
12/13/92	20	70428	4120	186.1	9.5	176.6	0.5	49.8
01/21/93	20	70467	4140	196.2	18.8	177.3	1.0	53.5
02/17/93	20	70494	4160	195.7	18.1	177.6	1.1	55.9
03/20/93	20	70525	4180	194.2	16.6	177.6	0.9	54.1
04/22/93	20	70558	4200	204.4	25.6	178.8	1.8	62.0
05/20/93	20	70586	4220	207.7	28.3	179.4	2.0	62.5
06/16/93	20	70613	4240	209.5	29.8	179.4	2.1	64.0
07/14/93	20	70641	4260	214.2	33.6	180.6	2.2	63.2
08/17/93	20	70675	4280	214.5	33.6	180.9	2.2	65.3
08/30/93	20	70688	4290	203.2	24.1	179.4	1.2	60.5
09/13/93	20	70702	4300	205.2	25.3	179.9	1.6	61.6
10/11/93	20	70730	4320	189.6	11.0	178.6	0.8	53.2
11/07/93	20	70757	4330	188.1	12.5	175.6	0.8	51.8
12/17/93	20	70797	4360	209.7	29.8	180.1	1.8	63.9
01/28/94	20	70839	4380	197.9	19.1	178.8	0.9	54.4
02/23/94	20	70865	4400	202.9	25.3	177.6	1.4	61.9
03/26/94	20	70896	4420	200.9	23.3	177.6	1.3	59.5
04/22/94	20	70923	4440	203.4	25.8	177.6	1.3	59.7
05/26/94	20	70957	4460	202.2	24.8	177.6	1.3	61.7
06/18/94	20	70980	4480	208.4	29.8	178.8	1.9	63.5
07/06/94	20	70998	4490	208.9	30.1	179.1	2.1	62.5
08/21/94	20	71044	4520	207.4	28.8	178.6	1.8	62.1
09/05/94	20	71059	4530	193.6	16.1	177.3	1.0	51.2
10/03/94	20	71087	4550	201.2	25.6	175.6	1.3	59.8
10/30/94	20	71114	4570	182.6	7.5	175.1	0.9	51.0
11/15/94	20	71130	4580	176.6	2.3	174.3	0.3	46.7
01/12/95	20	71188	4610	192.4	16.8	175.6	1.2	55.6
02/11/95	20	71218	4630	196.2	20.3	175.8	1.1	57.2
03/20/95	20	71255	4660	186.1	10.8	175.3	0.7	51.4
04/13/95	20	71279	4670	180.1	5.3	174.8	0.4	46.5
05/11/95	20	71307	4690	182.6	7.5	175.3	0.6	49.0
06/07/95	20	71334	4710	194.9	15.8	179.1	1.6	56.7
07/23/95	20	71380	4740	185.4	7.8	177.8	0.7	51.4
08/18/95	20	71406	4760	189.1	11.0	178.1	1.0	53.5
09/18/95	20	71437	4780	177.8	1.0	176.8	0.1	45.7

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
10/09/80	25	65980	1190	278.9	76.5	202.4	3.2	83.2
01/15/81	25	66078	1250	232.3	39.4	192.9	3.0	67.5
04/12/81	25	66165	1310	265.9	71.2	194.7	3.1	87.1
10/25/81	25	66361	1440	263.6	64.7	199.2	3.2	77.9
01/09/82	25	66437	1490	258.4	61.0	197.4	3.9	74.4
04/09/82	25	66527	1550	259.1	61.7	197.4	3.7	73.5
07/16/82	25	66625	1610	263.1	68.7	194.4	3.2	78.1
01/09/83	25	66802	1730	252.8	58.4	194.4	3.5	76.0
04/28/83	25	66911	1800	233.0	46.4	186.6	2.3	72.4
07/12/83	25	66986	1850	234.5	39.4	195.2	3.3	67.4
10/27/83	25	67093	1920	211.5	32.9	178.8	1.7	66.2
01/11/84	25	67169	1970	232.8	46.2	186.4	2.1	71.9
07/10/84	25	67350	2090	266.6	72.0	194.7	3.3	83.2
10/09/84	25	67441	2150	244.6	52.2	192.4	2.9	76.6
01/29/85	25	67553	2220	239.6	52.7	186.9	2.2	80.3
04/20/85	25	67634	2280	246.3	60.0	186.4	2.3	81.8
11/12/85	25	67840	2410	252.3	64.2	188.1	2.6	77.5
09/29/86	25	68161	2630	269.4	78.0	191.4	3.4	84.7
01/09/87	25	68263	2690	251.6	60.2	191.4	3.3	75.7
05/12/87	25	68386	2770	261.9	72.2	189.4	3.0	80.6
07/09/87	25	68444	2810	284.5	90.3	194.2	4.1	84.8
03/31/88	25	68710	2980	255.9	61.7	194.2	3.7	75.6
07/17/88	25	68818	3060	257.1	60.2	196.9	3.6	76.4
09/24/88	25	68887	3100	239.1	41.4	197.7	3.7	62.8
07/11/89	25	69177	3300	238.5	39.9	198.7	2.1	57.2
01/05/90	25	69355	3410	268.9	32.4	236.3	1.2	67.6
03/28/90	25	69437	3460	265.6	25.8	239.8	1.5	60.2
07/08/90	25	69539	3530	262.4	24.6	237.8	1.7	60.4
08/13/90	25	69575	3560	263.4	27.8	235.5	1.6	61.4
09/13/90	25	69606	3580	255.6	20.8	235.0	1.6	58.3
10/18/90	25	69641	3600	261.1	25.6	235.5	1.6	62.5
11/07/90	25	69661	3610	259.1	22.1	236.8	1.6	60.6
01/19/91	25	69734	3660	263.1	25.8	237.3	1.2	65.5
01/31/91	25	69746	3660	263.9	25.8	238.0	1.3	64.5
02/15/91	25	69761	3680	262.1	25.1	236.8	1.6	61.5
03/23/91	25	69797	3700	254.1	18.3	235.8	0.4	46.3
04/11/91	25	69816	3710	263.9	25.6	238.5	1.6	60.7
04/27/91	25	69832	3720	260.9	23.8	237.0	1.8	60.3
05/25/91	25	69860	3740	255.9	19.3	236.8	1.5	57.2
06/29/91	25	69895	3760	259.1	22.3	236.8	1.5	59.6
07/27/91	25	69923	3780	261.9	22.1	239.8	1.6	57.8
08/22/91	25	69949	3800	259.4	19.8	239.6	1.4	58.6
09/19/91	25	69977	3820	236.0	1.3	234.8	0.2	46.3
10/15/91	25	70003	3840	253.6	17.6	235.8	1.4	57.6
10/28/91	25	70016	3851	250.8	16.3	234.5	1.2	55.3
11/11/91	25	70030	3852	252.8	18.6	234.3	0.9	57.8
11/18/91	25	70037	3860	267.4	32.9	234.5	1.6	66.3
12/15/91	25	70064	3880	249.3	15.1	234.3	0.9	53.8
01/17/92	25	70097	3900	266.4	29.3	237.0	1.6	64.5
02/27/92	25	70138	3920	266.6	29.3	237.0	1.6	65.8
03/12/92	25	70152	3930	266.1	27.3	238.8	1.8	64.2
03/28/92	25	70168	3940	264.9	27.6	237.3	1.9	62.9
04/15/92	25	70186	3960	264.6	27.1	237.3	1.8	61.4
05/14/92	25	70215	3970	261.6	25.1	236.5	1.2	63.2
06/06/92	25	70238	3990	270.4	33.4	237.0	1.8	65.1
06/10/92	25	70242	3990	273.2	35.9	237.0	1.9	65.7
07/28/92	25	70290	4020	283.7	46.4	237.3	2.1	69.7
08/25/92	25	70318	4042	264.4	27.3	237.0	1.7	61.8
09/07/92	25	70331	4050	254.1	22.1	232.0	1.5	57.8
09/23/92	25	70347	4060	240.1	9.0	230.8	0.4	46.3
10/19/92	25	70373	4080	251.3	19.8	231.5	1.1	55.0
11/08/92	25	70393	4090	247.3	15.6	231.5	1.1	55.0
12/13/92	25	70428	4120	242.8	9.0	233.8	0.5	50.1
01/21/93	25	70467	4140	248.6	14.8	233.8	0.7	51.0
03/20/93	25	70525	4180	243.1	9.3	233.8	0.6	49.8
04/22/93	25	70558	4200	260.9	26.1	234.8	1.7	63.2
05/20/93	25	70586	4220	270.2	34.9	235.3	2.0	65.8

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
06/16/93	25	70613	4240	281.4	45.9	235.5	2.5	70.7
07/14/93	25	70641	4260	278.4	43.9	234.5	2.2	69.0
08/17/93	25	70675	4280	274.9	40.4	234.8	2.3	68.7
08/30/93	25	70688	4290	256.4	22.6	233.8	1.4	56.8
09/13/93	25	70702	4300	265.9	31.6	234.3	1.8	64.9
10/11/93	25	70730	4320	249.6	15.8	233.8	1.3	56.9
11/07/93	25	70757	4330	238.5	9.5	228.8	1.2	52.2
12/17/93	25	70797	4360	258.1	24.1	234.0	1.7	61.5
01/28/94	25	70839	4380	266.1	32.6	233.5	1.2	70.0
02/23/94	25	70865	4400	259.6	26.3	233.3	1.5	62.4
03/26/94	25	70896	4420	259.4	25.6	232.8	1.6	61.9
04/22/94	25	70923	4440	257.1	23.8	233.3	1.4	59.1
05/26/94	25	70957	4460	261.6	28.1	233.5	1.6	63.4
06/18/94	25	70980	4480	232.5	27.3	205.2	2.0	61.9
07/06/94	25	70998	4490	235.8	30.6	205.4	2.1	63.2
08/21/94	25	71044	4520	243.3	38.1	205.2	1.9	67.2
09/05/94	25	71059	4530	250.6	45.7	205.2	1.9	79.8
10/03/94	25	71087	4550	230.8	26.1	204.7	1.5	60.4
10/30/94	25	71114	4570	216.2	11.8	204.7	1.3	54.0
11/15/94	25	71130	4580	210.7	7.3	203.4	0.2	51.1
01/12/95	25	71188	4610	214.0	9.8	204.2	0.9	51.5
02/11/95	25	71218	4630	216.7	8.3	208.7	0.6	49.8
03/20/95	25	71255	4660	224.3	15.8	208.4	0.6	50.5
04/13/95	25	71279	4670	217.7	9.3	208.4	0.5	49.1
05/11/95	25	71307	4690	215.0	6.3	208.7	0.8	50.1
06/07/95	25	71334	4710	221.5	12.5	208.7	1.3	54.9
07/23/95	25	71380	4740	210.7	2.8	207.7	0.3	46.3
08/18/95	25	71406	4760	220.7	14.3	206.7	1.1	54.9
09/18/95	25	71437	4780	216.7	10.3	206.7	1.1	53.5

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
01/05/90	41	69355	3410	196.7	10.8	185.9	0.5	48.0
03/27/90	41	69436	3460	204.2	20.3	184.1	1.2	55.1
08/13/90	41	69575	3560	222.5	35.9	186.9	1.9	64.9
09/13/90	41	69606	3580	216.5	29.6	186.9	2.0	61.0
10/18/90	41	69641	3600	214.0	27.1	186.9	1.8	62.0
11/07/90	41	69661	3610	207.2	20.3	186.9	1.4	59.8
01/19/91	41	69734	3660	200.9	14.0	186.9	0.9	52.3
01/31/91	41	69746	3660	210.0	25.1	184.6	1.2	61.9
02/15/91	41	69761	3680	212.2	25.3	186.9	1.9	59.9
03/23/91	41	69797	3700	209.2	22.3	186.9	1.9	58.0
04/11/91	41	69816	3710	201.9	18.1	183.9	1.2	56.1
04/27/91	41	69832	3720	204.9	15.3	189.6	1.0	56.0
05/25/91	41	69860	3740	201.7	12.3	189.6	1.2	52.2
06/29/91	41	69895	3760	235.0	45.7	189.6	1.3	74.8
07/27/91	41	69923	3780	215.2	23.8	191.4	1.9	58.8
08/22/91	41	69949	3800	217.0	25.6	191.4	1.5	62.1
09/19/91	41	69977	3820	199.4	5.3	193.9	0.8	49.9
10/15/91	41	70003	3840	213.5	19.1	194.4	1.4	58.9
10/28/91	41	70016	3851	210.2	18.8	191.6	1.6	58.1
11/11/91	41	70030	3852	204.4	12.8	191.6	0.8	52.7
11/18/91	41	70037	3860	215.0	23.3	191.6	1.6	61.1
12/15/91	41	70064	3880	199.7	8.0	191.6	0.4	47.2
01/17/92	41	70097	3900	221.2	31.4	190.1	1.6	64.8
02/27/92	41	70138	3920	216.2	26.1	190.1	1.6	63.6
03/28/92	41	70168	3940	218.5	28.3	190.1	1.8	63.5
04/15/92	41	70186	3960	215.0	24.8	190.1	1.7	59.2
05/14/92	41	70215	3970	213.2	23.3	189.9	1.2	62.9
06/10/92	41	70242	3990	221.0	31.1	189.9	2.0	64.3
07/28/92	41	70290	4020	217.7	27.8	189.9	2.0	62.0
08/25/92	41	70318	4042	207.9	18.1	189.9	1.1	56.5
09/07/92	41	70331	4050	211.0	19.1	191.9	1.0	54.9
09/23/92	41	70347	4060	193.6	1.8	191.9	-0.6	47.2
10/19/92	41	70373	4080	195.2	3.0	191.9	-0.0	47.2
11/08/92	41	70393	4090	199.9	8.0	191.9	0.7	51.0
12/13/92	41	70428	4120	197.7	4.8	192.9	0.2	47.2
01/21/93	41	70467	4140	195.9	3.3	192.9	-0.2	47.2
02/17/93	41	70494	4160	197.7	4.8	192.9	0.6	49.1
03/20/93	41	70525	4180	208.7	16.3	192.4	3.2	53.6
04/22/93	41	70558	4200	227.5	35.1	192.4	1.7	68.8
05/20/93	41	70586	4220	219.0	26.6	192.4	1.9	63.2
06/16/93	41	70613	4240	231.3	38.9	192.4	2.2	67.5
07/14/93	41	70641	4260	240.8	50.9	189.9	2.3	70.5
08/17/93	41	70675	4280	234.3	41.9	192.4	2.4	72.4
08/30/93	41	70688	4290	226.8	36.9	189.9	1.5	69.5
09/13/93	41	70702	4300	229.0	39.1	189.9	2.0	69.6
10/11/93	41	70730	4320	216.2	26.3	189.9	1.6	62.1
11/07/93	41	70757	4330	211.2	21.3	189.9	1.4	59.4
12/17/93	41	70797	4360	213.7	23.8	189.9	1.8	60.6
01/28/94	41	70839	4380	209.2	19.3	189.9	0.9	53.7
02/23/94	41	70865	4400	214.2	23.6	190.6	1.3	61.5
03/26/94	41	70896	4420	213.2	22.8	190.6	1.3	60.0
04/22/94	41	70923	4440	217.0	26.6	190.6	1.4	62.2
05/26/94	41	70957	4460	214.7	24.1	190.6	1.0	61.8
06/18/94	41	70980	4480	217.7	27.3	190.4	2.0	61.6
07/06/94	41	70998	4490	223.0	32.6	190.4	1.9	65.6
08/21/94	41	71044	4520	223.7	33.4	190.4	1.7	65.4
09/05/94	41	71059	4530	213.5	23.1	190.4	1.2	60.9
10/03/94	41	71087	4550	214.2	22.6	191.6	1.4	57.8
10/30/94	41	71114	4570	206.4	14.8	191.6	1.2	54.3
11/15/94	41	71130	4580	198.2	6.5	191.6	0.4	47.2
01/12/95	41	71188	4610	200.9	9.0	191.6	0.8	50.3
02/11/95	41	71218	4630	204.2	11.5	192.6	1.0	54.2
03/20/95	41	71255	4660	205.9	13.3	192.6	1.2	55.6
04/13/95	41	71279	4670	208.9	16.1	192.6	0.9	53.9
05/11/95	41	71307	4690	215.0	22.3	192.6	2.0	59.3
06/07/95	41	71334	4710	215.2	21.1	194.2	4.4	59.7
07/23/95	41	71380	4740	196.4	2.5	193.9	0.2	47.2

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
08/18/95	41	71406	4760	191.6	13.5	178.1	1.2	55.4
09/18/95	41	71437	4780	184.4	6.3	178.1	0.8	49.9

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
08/14/90	46	69576	3560	160.5	30.6	129.9	2.0	62.0
09/13/90	46	69606	3580	157.8	27.6	130.2	1.2	53.4
10/18/90	46	69641	3600	161.0	27.8	133.4	1.9	62.0
11/07/90	46	69661	3610	131.9	14.3	117.6	0.7	55.8
01/19/91	46	69734	3660	140.7	20.8	119.9	0.9	54.9
02/15/91	46	69761	3680	158.0	34.4	123.7	1.6	86.9
03/24/91	46	69798	3700	146.7	19.8	126.9	1.4	57.4
04/27/91	46	69832	3720	119.1	8.5	110.6	0.2	44.9
05/25/91	46	69860	3740	119.1	9.5	109.6	0.8	49.9
06/29/91	46	69895	3760	139.0	17.3	121.4	1.4	54.9
07/27/91	46	69923	3780	143.7	22.8	120.9	1.7	59.2
08/22/91	46	69949	3800	151.0	25.1	126.2	1.5	61.1
09/19/91	46	69977	3820	149.8	20.1	129.7	1.5	59.1
10/15/91	46	70003	3840	154.0	21.8	131.9	1.6	60.1
10/29/91	46	70017	3851	139.2	15.8	123.4	1.2	57.4
11/18/91	46	70037	3860	134.7	19.1	115.6	1.4	59.0
12/15/91	46	70064	3880	129.9	11.3	118.6	0.7	51.8
01/17/92	46	70097	3900	135.7	26.8	108.9	1.5	63.5
02/27/92	46	70138	3920	171.6	26.6	145.0	1.3	65.0
03/28/92	46	70168	3940	182.1	29.8	152.5	1.6	64.6
04/15/92	46	70186	3960	171.8	23.8	148.0	1.4	59.2
05/14/92	46	70215	3970	146.2	20.6	125.7	0.8	59.8
06/10/92	46	70242	3990	162.5	24.1	138.5	1.9	60.5
07/28/92	46	70290	4020	164.0	21.6	142.2	1.7	59.4
08/25/92	46	70318	4042	157.8	18.8	139.0	1.2	57.1
09/07/92	46	70331	4050	163.8	20.6	143.0	1.0	56.9
09/23/92	46	70347	4060	140.7	15.3	125.4	0.7	51.3
10/19/92	46	70373	4080	126.7	11.8	114.9	0.1	42.5
11/08/92	46	70393	4090	134.2	10.8	123.4	0.7	50.7
12/13/92	46	70428	4120	97.3	1.0	96.3	-0.1	38.4
01/21/93	46	70467	4140	135.7	20.1	115.4	0.8	56.3
02/17/93	46	70494	4160	112.6	6.3	106.4	0.5	48.3
03/20/93	46	70525	4180	133.9	10.3	123.7	0.6	50.6
04/22/93	46	70558	4200	159.3	35.1	124.4	1.5	70.2
05/20/93	46	70586	4220	192.1	42.9	149.5	1.7	71.0
06/16/93	46	70613	4240	177.6	41.1	136.5	2.0	67.7
07/14/93	46	70641	4260	175.1	36.1	139.0	1.9	65.0
08/17/93	46	70675	4280	175.1	36.4	139.0	1.9	69.4
08/30/93	46	70688	4290	177.6	35.6	142.0	1.5	70.8
09/13/93	46	70702	4300	181.4	41.6	139.7	1.6	70.4
10/11/93	46	70730	4320	158.3	20.3	138.0	1.1	60.3
11/07/93	46	70757	4330	165.1	20.8	144.2	1.6	59.1
12/17/93	46	70797	4360	162.8	24.8	138.0	2.0	60.8
01/28/94	46	70839	4380	152.0	19.3	132.7	0.9	55.2
02/23/94	46	70865	4400	153.3	21.1	132.2	0.8	60.5
03/26/94	46	70896	4420	155.3	24.1	131.2	1.2	61.2
04/22/94	46	70923	4440	160.8	27.6	133.2	1.3	64.4
05/26/94	46	70957	4460	140.2	18.6	121.9	0.5	55.4
06/18/94	46	70980	4480	156.3	24.6	131.7	1.5	61.2
07/06/94	46	70998	4490	173.1	36.6	136.5	1.6	69.1
08/21/94	46	71044	4520	169.8	30.6	139.5	1.9	62.4
09/05/94	46	71059	4530	152.8	26.3	126.4	0.8	66.9
10/03/94	46	71087	4550	146.0	13.0	132.9	1.2	55.2
10/30/94	46	71114	4570	143.2	23.1	120.2	1.3	61.2
11/15/94	46	71130	4580	110.6	11.3	99.3	0.5	50.7
01/12/95	46	71188	4610	128.2	16.8	111.6	0.7	53.5
02/11/95	46	71218	4630	130.7	16.1	114.6	0.8	54.1
03/20/95	46	71255	4660	129.2	15.1	114.1	0.7	53.0
04/13/95	46	71279	4670	130.9	16.8	114.1	0.7	55.3
05/11/95	46	71307	4690	150.0	17.1	132.9	1.6	57.2
06/07/95	46	71334	4710	181.4	39.6	142.0	1.9	68.4
07/23/95	46	71380	4740	167.8	33.1	134.7	1.6	68.6
08/18/95	46	71406	4760	160.3	17.6	143.0	1.3	57.1
09/18/95	46	71437	4780	162.0	15.3	146.7	1.6	56.1

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
08/14/90	47	69576	3560	184.9	28.1	156.8	1.8	61.5
09/13/90	47	69606	3580	173.1	20.6	152.5	2.0	58.0
10/18/90	47	69641	3600	178.1	24.8	153.0	1.9	61.4
11/07/90	47	69661	3610	148.7	13.0	135.7	0.6	54.0
01/19/91	47	69734	3660	154.3	20.3	133.9	0.7	54.8
02/15/91	47	69761	3680	175.8	36.4	139.5	1.4	68.9
03/24/91	47	69798	3700	161.0	18.6	142.5	1.0	58.8
04/27/91	47	69832	3720	151.8	16.3	135.5	0.6	54.2
05/25/91	47	69860	3740	141.7	11.0	130.7	0.6	49.0
06/29/91	47	69895	3760	155.3	15.1	140.2	1.3	53.5
08/22/91	47	69949	3800	157.3	18.1	139.2	1.5	58.2
09/19/91	47	69977	3820	190.9	25.8	165.1	1.8	62.1
10/15/91	47	70003	3840	171.8	20.6	151.3	1.6	58.9
10/29/91	47	70017	3851	151.5	15.8	135.7	1.0	57.1
11/18/91	47	70037	3860	147.2	18.1	129.2	1.2	58.8
12/15/91	47	70064	3880	136.7	10.0	126.7	0.7	51.6
01/17/92	47	70097	3900	153.3	29.6	123.7	1.4	64.8
02/27/92	47	70138	3920	173.6	24.3	149.2	1.1	64.2
03/28/92	47	70168	3940	181.4	27.3	154.0	1.5	64.6
04/15/92	47	70186	3960	174.8	23.3	151.5	1.2	59.0
05/14/92	47	70215	3970	156.5	21.6	135.0	1.0	60.0
06/10/92	47	70242	3990	165.3	20.1	145.5	1.5	58.9
07/28/92	47	70290	4020	165.3	18.3	147.0	1.4	58.2
08/25/92	47	70318	4042	160.3	16.3	144.2	0.9	55.2
09/07/92	47	70331	4050	167.3	19.8	147.5	1.0	56.5
09/23/92	47	70347	4060	114.6	3.0	111.6	0.2	43.5
10/19/92	47	70373	4080	132.7	13.5	119.1	0.2	42.6
11/08/92	47	70393	4090	131.7	7.3	124.4	0.3	46.3
12/13/92	47	70428	4120	95.1	0.5	94.6	-0.1	38.6
01/21/93	47	70467	4140	118.1	9.3	108.9	0.5	48.8
02/17/93	47	70494	4160	110.1	5.3	104.9	0.3	45.5
03/20/93	47	70525	4180	128.2	8.0	120.2	0.5	49.7
04/22/93	47	70558	4200	153.8	33.9	119.9	1.1	70.2
05/20/93	47	70586	4220	171.8	43.1	128.7	1.9	69.8
06/16/93	47	70613	4240	172.6	40.4	132.2	2.2	68.6
07/14/93	47	70641	4260	186.1	54.7	131.4	2.2	75.2
08/17/93	47	70675	4280	166.8	37.1	129.7	2.0	72.2
08/30/93	47	70688	4290	164.6	36.6	127.9	1.2	71.7
09/13/93	47	70702	4300	153.8	27.6	126.2	1.6	59.3
10/11/93	47	70730	4320	150.8	25.8	124.9	0.9	63.4
11/07/93	47	70757	4330	149.2	20.6	128.9	1.2	59.0
12/17/93	47	70797	4360	149.2	20.8	128.4	1.5	59.9
01/28/94	47	70839	4380	81.5	0.5	81.0	-0.2	37.9
02/23/94	47	70865	4400	144.0	20.3	123.7	0.8	59.7
03/26/94	47	70896	4420	145.5	21.8	123.9	1.0	59.6
04/22/94	47	70923	4440	148.0	23.6	124.4	1.0	60.1
05/26/94	47	70957	4460	139.2	21.8	117.1	0.7	59.6
06/18/94	47	70980	4480	148.0	23.1	125.2	1.2	60.3
07/06/94	47	70998	4490	170.3	41.1	129.2	1.3	69.8
08/21/94	47	71044	4520	161.8	30.1	131.7	1.3	64.1
09/05/94	47	71059	4530	143.0	24.6	118.4	0.5	63.6
10/03/94	47	71087	4550	151.5	17.8	133.4	1.2	56.1
10/30/94	47	71114	4570	166.8	34.9	131.7	1.8	65.3
11/15/94	47	71130	4580	117.1	10.0	107.1	0.5	48.7
01/12/95	47	71188	4610	126.2	13.8	112.4	0.6	51.7
02/11/95	47	71218	4630	122.4	15.6	106.9	0.5	52.1
03/20/95	47	71255	4660	130.2	15.8	114.4	0.6	53.0
04/13/95	47	71279	4670	99.8	7.3	92.6	0.4	45.5
05/11/95	47	71307	4690	144.0	14.8	129.2	1.3	55.7
06/07/95	47	71334	4710	168.3	29.8	138.5	1.8	64.1
07/23/95	47	71380	4740	179.1	40.1	139.0	2.2	68.8
08/18/95	47	71406	4760	136.7	9.3	127.4	0.9	52.6
09/18/95	47	71437	4780	161.5	20.8	141.0	1.4	57.1

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
08/14/90	54	69576	3560	173.1	29.8	143.2	1.6	62.4
09/13/90	54	69606	3580	174.8	18.6	156.5	1.7	57.0
10/18/90	54	69641	3600	177.8	24.3	153.5	1.6	62.0
11/07/90	54	69661	3610	155.5	13.0	142.5	1.0	53.1
01/19/91	54	69734	3660	156.5	22.3	134.2	0.8	61.8
02/15/91	54	69761	3680	163.8	25.6	138.5	1.3	62.3
03/24/91	54	69798	3700	150.5	16.6	133.9	0.7	54.4
04/27/91	54	69832	3720	147.5	9.8	137.7	0.5	48.1
06/29/91	54	69895	3760	163.3	24.1	139.2	1.3	61.3
07/27/91	54	69923	3780	156.0	13.8	142.2	1.0	53.2
08/22/91	54	69949	3800	160.0	14.3	145.7	1.0	55.7
09/19/91	54	69977	3820	153.3	11.8	141.5	0.6	51.0
10/29/91	54	70017	3851	160.0	15.8	144.2	1.1	56.0
11/11/91	54	70030	3852	159.3	23.3	136.2	1.2	61.4
11/18/91	54	70037	3860	161.3	22.6	138.7	1.7	60.5
12/15/91	54	70064	3880	136.7	6.8	129.9	0.5	47.9
01/17/92	54	70097	3900	158.8	25.3	133.4	1.5	62.2
02/27/92	54	70138	3920	160.5	23.3	137.2	1.1	62.9
03/28/92	54	70168	3940	165.1	20.1	145.0	1.2	59.7
04/15/92	54	70186	3960	153.8	16.6	137.2	0.8	54.9
05/14/92	54	70215	3970	150.3	20.1	130.2	1.0	58.8
06/10/92	54	70242	3990	149.5	13.3	136.2	0.8	54.2
06/30/92	54	70262	4010	136.0	9.5	126.4	0.5	51.3
07/28/92	54	70290	4020	146.2	9.3	137.2	0.7	51.1
08/25/92	54	70318	4042	149.8	13.5	136.2	0.7	54.2
09/07/92	54	70331	4050	146.0	12.8	133.2	0.5	50.3
09/23/92	54	70347	4060	131.2	19.6	111.9	0.4	48.1
10/19/92	54	70373	4080	133.2	11.0	122.2	0.3	45.4
11/08/92	54	70393	4090	135.0	8.3	126.7	0.6	50.7
12/13/92	54	70428	4120	94.8	10.0	84.8	0.2	28.0
01/21/93	54	70467	4140	113.4	10.5	102.8	0.2	36.6
02/17/93	54	70494	4160	98.3	4.5	93.6	0.1	36.5
03/20/93	54	70525	4180	116.1	11.0	105.1	0.3	43.8
04/22/93	54	70558	4200	148.2	24.6	123.7	1.4	63.8
05/20/93	54	70586	4220	166.1	20.1	146.0	1.4	59.1
06/16/93	54	70613	4240	169.8	25.1	144.5	1.3	63.2
07/14/93	54	70641	4260	168.6	19.8	148.7	1.8	57.9
08/17/93	54	70675	4280	158.5	15.6	143.0	0.9	56.0
08/30/93	54	70688	4290	174.1	28.1	146.0	1.2	63.9
09/13/93	54	70702	4300	162.5	21.3	141.2	1.0	61.0
10/11/93	54	70730	4320	141.7	8.8	132.9	0.6	51.1
11/07/93	54	70757	4330	149.0	11.8	137.2	0.6	50.5
12/17/93	54	70797	4360	142.0	11.5	130.4	0.9	53.8
01/28/94	54	70839	4380	128.9	7.8	120.9	0.4	46.3
02/23/94	54	70865	4400	154.5	19.8	134.7	0.6	55.4
03/26/94	54	70896	4420	148.7	24.6	124.2	0.6	66.9
04/22/94	54	70923	4440	147.7	17.8	130.2	0.8	56.2
05/26/94	54	70957	4460	130.4	15.1	115.4	0.3	42.8
06/18/94	54	70980	4480	168.8	19.1	149.8	1.0	57.4
07/06/94	54	70998	4490	168.1	29.6	138.5	1.5	63.9
08/21/94	54	71044	4520	156.5	19.6	137.0	0.9	55.8
09/05/94	54	71059	4530	132.7	13.8	119.1	0.3	43.3
10/03/94	54	71087	4550	146.0	15.3	130.7	0.7	53.4
10/30/94	54	71114	4570	148.5	7.0	141.5	0.7	50.3
11/15/94	54	71130	4580	123.7	9.5	114.1	0.2	45.1
01/12/95	54	71188	4610	118.1	12.5	105.6	0.4	46.3
02/11/95	54	71218	4630	123.9	13.0	110.9	0.5	50.5
03/20/95	54	71255	4660	125.2	14.5	110.6	0.4	48.0
04/13/95	54	71279	4670	101.1	4.8	96.3	0.2	40.1
05/11/95	54	71307	4690	104.6	0.5	104.3	-0.3	39.5
06/07/95	54	71334	4710	101.6	1.3	100.3	0.1	44.3
07/23/95	54	71380	4740	164.0	27.3	136.5	1.3	59.0
08/18/95	54	71406	4760	142.2	9.5	132.7	0.8	52.0
09/18/95	54	71437	4780	159.5	15.8	143.5	1.4	56.0

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
10/09/80	60	65980	1190	293.7	77.0	216.7	4.4	77.8
01/15/81	60	66078	1250	267.9	52.4	215.2	3.9	69.8
04/26/81	60	66179	1320	279.7	73.5	205.9	3.3	87.7
07/14/81	60	66258	1370	304.0	89.5	214.5	4.8	83.2
10/21/81	60	66357	1440	296.7	78.0	218.5	4.5	79.6
01/08/82	60	66436	1490	293.2	84.0	209.2	4.4	83.2
07/16/82	60	66625	1610	277.7	69.2	208.4	4.5	76.0
01/09/83	60	66802	1730	248.6	50.4	198.4	2.0	79.3
04/20/83	60	66903	1800	246.1	44.4	201.7	2.1	72.0
07/12/83	60	66986	1850	255.4	47.7	207.4	2.8	71.6
10/27/83	60	67093	1920	260.1	40.9	219.2	1.7	72.5
01/06/84	60	67164	1970	270.9	48.4	222.7	2.7	73.5
07/10/84	60	67350	2090	253.1	57.9	195.2	3.1	76.2
10/20/84	60	67452	2160	244.3	50.4	193.6	2.5	71.3
01/29/85	60	67553	2220	236.0	50.4	185.6	2.4	77.6
04/24/85	60	67638	2280	253.3	57.7	195.7	2.4	77.0
07/08/85	60	67713	2330	236.5	50.2	186.4	2.2	73.2
08/14/90	60	69576	3560	167.8	28.1	139.7	1.8	61.2
09/13/90	60	69606	3580	166.1	21.6	144.5	1.6	55.6
10/18/90	60	69641	3600	154.5	12.8	141.7	1.2	55.3
11/07/90	60	69661	3610	145.2	12.3	132.9	0.9	53.6
01/19/91	60	69734	3660	139.7	13.8	125.9	0.5	51.5
02/15/91	60	69761	3680	153.0	21.8	131.4	0.9	60.7
03/23/91	60	69797	3700	132.7	9.3	123.4	0.3	43.9
04/27/91	60	69832	3720	141.5	7.5	134.2	0.9	51.2
05/25/91	60	69860	3740	146.5	19.8	126.7	1.2	58.9
06/29/91	60	69895	3760	135.7	6.3	129.2	0.7	49.6
07/27/91	60	69923	3780	141.2	9.5	131.7	0.9	52.5
08/22/91	60	69949	3800	161.3	20.1	141.2	1.4	58.0
09/19/91	60	69977	3820	149.2	14.3	134.7	0.7	54.9
10/15/91	60	70003	3840	155.3	16.3	139.0	1.0	55.5
10/29/91	60	70017	3851	146.2	18.3	127.7	1.0	59.6
11/18/91	60	70037	3860	172.8	23.8	149.0	1.7	61.3
12/15/91	60	70064	3880	136.7	8.0	128.7	0.4	47.5
01/17/92	60	70097	3900	149.5	22.1	127.7	1.4	60.8
02/27/92	60	70138	3920	145.2	17.1	127.9	0.9	59.6
03/27/92	60	70167	3940	143.5	11.3	132.2	0.8	52.4
04/15/92	60	70186	3960	140.5	10.8	129.7	0.5	49.9
05/14/92	60	70215	3970	131.4	12.3	118.9	0.7	50.9
06/10/92	60	70242	3990	122.4	6.3	116.1	0.4	46.5
07/28/92	60	70290	4020	131.4	8.5	123.2	0.6	50.3
08/25/92	60	70318	4042	130.9	7.8	122.9	0.6	51.0
09/07/92	60	70331	4050	134.2	12.3	121.9	0.6	50.8
09/23/92	60	70347	4060	114.1	13.5	100.6	0.5	49.5
10/19/92	60	70373	4080	115.1	10.3	104.9	0.4	45.8
11/08/92	60	70393	4090	116.6	2.8	113.9	0.2	44.1
12/13/92	60	70428	4120	98.1	7.8	90.3	0.2	36.7
01/21/93	60	70467	4140	90.6	3.5	87.0	-0.0	31.3
02/17/93	60	70494	4160	86.5	2.5	84.0	0.0	35.1
03/20/93	60	70525	4180	91.1	2.3	88.5	-0.1	34.3
04/22/93	60	70558	4200	126.4	15.6	110.9	1.2	58.4
05/20/93	60	70586	4220	136.2	10.3	126.2	0.9	52.9
06/16/93	60	70613	4240	151.0	19.1	131.9	1.3	58.9
07/14/93	60	70641	4260	144.0	12.5	131.4	1.4	54.5
08/17/93	60	70675	4280	142.0	14.5	127.4	0.9	54.5
08/30/93	60	70688	4290	133.2	16.3	116.6	0.8	57.9
09/13/93	60	70702	4300	136.5	15.1	121.4	0.9	56.0
10/11/93	60	70730	4320	129.4	9.8	119.7	0.5	49.8
11/07/93	60	70757	4330	127.9	9.5	118.6	0.5	49.7
12/17/93	60	70797	4360	133.7	14.8	118.9	1.1	56.6
01/28/94	60	70839	4380	115.4	5.5	109.9	0.2	42.8
02/23/94	60	70865	4400	116.9	10.8	106.1	0.4	45.0
03/26/94	60	70896	4420	123.9	11.5	112.4	0.5	50.2
04/22/94	60	70923	4440	132.9	14.3	118.4	0.8	52.9
05/26/94	60	70957	4460	115.1	11.0	104.1	0.2	43.6
06/18/94	60	70980	4480	137.7	16.6	120.9	1.0	56.8
07/06/94	60	70998	4490	151.3	26.8	124.4	1.4	62.6

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
08/21/94	60	71044	4520	141.2	15.8	125.2	0.8	54.6
09/05/94	60	71059	4530	128.2	16.1	112.1	0.3	44.7
10/03/94	60	71087	4550	128.7	14.8	113.6	0.6	53.6
10/30/94	60	71114	4570	138.2	12.8	125.7	0.9	53.2
11/15/94	60	71130	4580	102.8	5.0	97.6	0.1	40.1
01/12/95	60	71188	4610	104.9	7.8	97.1	0.3	43.4
02/11/95	60	71218	4630	104.3	8.5	95.8	0.3	45.0
03/20/95	60	71255	4660	117.4	13.3	104.1	0.4	48.2
04/13/95	60	71279	4670	115.9	13.3	102.6	0.4	45.7
05/11/95	60	71307	4690	126.7	9.8	116.6	0.9	51.8
06/07/95	60	71334	4710	89.8	0.5	89.5	-0.2	40.2
07/23/95	60	71380	4740	130.9	15.3	115.6	0.8	53.5
08/18/95	60	71406	4760	117.1	4.8	112.4	0.4	46.7
09/18/95	60	71437	4780	120.2	1.8	118.4	0.1	44.2

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
12/05/83	70	67132	1950	266.9	72.2	194.4	2.8	84.8
01/05/84	70	67163	1970	261.9	65.5	196.4	2.9	84.1
02/02/84	70	67191	1990	269.7	70.5	199.2	3.1	82.0
06/03/86	70	68043	2550	277.2	69.2	207.9	3.5	79.6
08/13/90	70	69575	3560	221.7	27.6	194.2	2.0	62.8
10/18/90	70	69641	3600	218.0	24.1	193.9	1.8	63.1
01/19/91	70	69734	3660	204.9	13.8	191.4	0.9	57.3
01/30/91	70	69745	3660	204.2	13.5	190.6	0.5	52.9
02/15/91	70	69761	3680	207.4	13.5	193.9	1.7	54.8
03/23/91	70	69797	3700	208.9	15.1	193.9	1.8	56.7
04/16/91	70	69821	3720	212.0	17.8	194.2	1.1	57.0
04/27/91	70	69832	3720	213.2	20.3	192.9	1.5	61.5
05/25/91	70	69860	3740	212.7	20.1	192.4	1.3	61.7
07/27/91	70	69923	3780	219.0	23.3	195.7	1.4	62.9
08/22/91	70	69949	3800	224.8	28.6	196.2	1.8	65.0
09/19/91	70	69977	3820	218.7	23.8	194.9	1.6	59.9
10/06/91	70	69994	3830	215.0	21.3	193.4	1.6	61.1
10/15/91	70	70003	3840	214.2	20.3	193.9	1.3	61.9
10/28/91	70	70016	3851	215.5	21.3	193.9	1.2	63.7
11/18/91	70	70037	3860	226.8	32.1	194.7	1.6	67.4
12/15/91	70	70064	3880	210.5	16.8	193.9	1.0	57.6
01/17/92	70	70097	3900	214.0	21.3	192.6	1.2	60.9
02/27/92	70	70138	3920	217.0	24.1	192.9	1.3	64.3
03/06/92	70	70146	3930	217.0	23.6	193.4	1.4	62.0
03/27/92	70	70167	3940	202.2	10.3	191.9	0.9	55.0
04/15/92	70	70186	3960	203.4	12.3	191.1	0.6	51.8
05/14/92	70	70215	3970	202.9	13.5	189.4	-0.3	46.6
06/07/92	70	70239	3990	204.7	12.3	192.4	0.7	51.0
06/10/92	70	70242	3990	205.4	13.0	192.4	0.8	53.9
07/28/92	70	70290	4020	221.2	26.8	194.4	1.6	64.6
08/25/92	70	70318	4042	227.5	33.1	194.7	1.7	67.1
09/07/92	70	70331	4050	219.7	25.8	193.9	1.7	62.5
09/23/92	70	70347	4060	187.4	1.5	185.9	-0.7	46.6
10/19/92	70	70373	4080	197.4	9.8	187.6	0.3	47.9
11/08/92	70	70393	4090	194.9	6.8	188.1	0.5	50.1
12/18/92	70	70433	4120	186.1	0.8	185.4	-0.9	46.6
01/21/93	70	70467	4140	187.1	1.8	185.4	-0.6	46.6
02/17/93	70	70494	4160	187.1	1.8	185.4	-0.3	46.6
03/20/93	70	70525	4180	187.9	2.5	185.4	0.2	46.6
04/22/93	70	70558	4200	215.2	26.3	188.9	1.7	64.8
05/20/93	70	70586	4220	216.5	26.8	189.4	1.9	64.0
06/16/93	70	70613	4240	218.2	28.3	189.9	2.1	65.1
07/14/93	70	70641	4260	222.7	32.6	190.1	2.0	65.8
07/26/93	70	70653	4260	225.5	33.9	191.6	2.1	67.9
08/17/93	70	70675	4280	189.6	3.5	186.4	0.4	49.1
08/30/93	70	70688	4290	209.2	21.1	188.4	1.3	60.5
09/13/93	70	70702	4300	213.0	24.1	188.9	1.5	63.0
10/11/93	70	70730	4320	193.9	7.5	186.6	0.6	51.0
11/07/93	70	70757	4330	197.2	8.5	188.6	0.6	51.3
12/17/93	70	70797	4360	201.2	13.0	188.1	1.1	55.0
01/28/94	70	70839	4380	200.4	14.8	185.6	0.1	46.6
02/23/94	70	70865	4400	218.0	27.3	190.6	1.2	66.4
03/26/94	70	70896	4420	204.7	15.1	189.4	0.8	55.1
04/22/94	70	70923	4440	217.5	26.8	190.9	1.3	64.1
05/26/94	70	70957	4460	208.2	18.6	189.6	0.9	54.6
06/18/94	70	70980	4480	226.8	36.4	190.4	1.6	70.2
07/06/94	70	70998	4490	234.8	44.1	190.6	1.7	73.7
08/21/94	70	71044	4520	225.0	33.9	191.1	1.8	66.8
09/05/94	70	71059	4530	208.9	20.1	188.9	0.8	51.9
10/03/94	70	71087	4550	203.9	16.6	187.4	1.1	57.9
10/30/94	70	71114	4570	211.7	22.6	189.1	1.7	62.1
11/15/94	70	71130	4580	192.6	6.3	186.1	0.4	49.2
01/12/95	70	71188	4610	197.9	11.5	186.4	0.6	50.9
02/11/95	70	71218	4630	205.7	17.1	188.6	1.1	57.0
03/20/95	70	71255	4660	206.2	17.8	188.4	0.9	57.0
04/13/95	70	71279	4670	204.9	16.6	188.4	0.9	55.7
05/11/95	70	71307	4690	203.9	15.1	189.1	1.2	56.2

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
06/07/95	70	71334	4710	209.5	12.3	196.9	1.3	56.4
07/23/95	70	71380	4740	211.7	15.3	196.4	1.2	59.6
08/18/95	70	71406	4760	198.7	10.8	187.6	1.0	54.1
09/18/95	70	71437	4780	214.7	24.8	189.6	1.8	62.9

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
10/09/80	74	65980	1190	295.5	128.2	167.3	3.5	91.9
01/15/81	74	66078	1250	276.2	88.0	187.9	5.0	74.8
04/12/81	74	66165	1310	321.6	131.7	189.9	5.2	95.6
07/14/81	74	66258	1370	303.5	115.9	187.6	5.1	86.7
10/20/81	74	66356	1440	302.3	117.6	184.9	4.1	90.1
01/08/82	74	66436	1490	327.6	136.7	190.9	5.4	86.8
04/08/82	74	66526	1550	330.1	136.7	193.4	5.4	87.1
07/16/82	74	66625	1610	317.6	124.7	192.9	5.5	85.1
01/09/83	74	66802	1730	296.7	105.1	191.6	5.5	88.1
04/28/83	74	66911	1800	282.9	91.1	191.9	5.5	82.6
07/12/83	74	66986	1850	289.0	95.3	193.6	5.0	83.6
10/27/83	74	67093	1920	264.1	72.2	191.9	4.8	80.1
12/05/83	74	67132	1950	265.1	71.0	194.2	5.0	79.7
01/08/84	74	67166	1970	276.2	85.8	190.4	4.9	85.1
02/02/84	74	67191	1990	273.2	80.5	192.6	4.8	81.8
07/10/84	74	67350	2090	261.1	69.2	191.9	4.4	78.3
10/08/84	74	67440	2150	281.9	89.8	192.1	4.4	87.8
01/29/85	74	67553	2220	274.7	81.0	193.6	4.2	89.9
04/04/85	74	67618	2270	287.2	94.3	193.1	4.4	92.7
07/08/85	74	67713	2330	267.6	82.0	185.4	3.9	82.1
11/12/85	74	67840	2410	259.4	70.2	189.4	3.8	80.0
06/03/86	74	68043	2550	274.4	79.5	194.9	4.5	81.1
07/09/86	74	68079	2570	276.2	82.5	193.6	4.3	82.0
09/29/86	74	68161	2630	264.4	69.7	194.7	4.4	77.9
01/09/87	74	68263	2690	244.3	53.9	190.4	2.4	74.6
05/12/87	74	68386	2770	239.3	60.5	178.8	1.8	84.0
07/09/87	74	68444	2810	240.1	61.0	179.1	2.2	79.7
03/31/88	74	68710	2980	225.8	44.1	181.9	2.1	71.8
07/17/88	74	68818	3060	214.2	42.4	171.6	1.5	72.9
09/24/88	74	68887	3100	197.9	24.8	173.1	1.4	60.1
07/10/89	74	69176	3290	222.2	44.1	178.3	1.9	72.5
01/04/90	74	69354	3410	187.1	6.5	180.6	0.6	51.5
03/27/90	74	69436	3460	200.9	19.6	181.1	1.2	57.3
01/30/91	74	69745	3660	192.6	13.0	179.6	0.2	49.1
04/16/91	74	69821	3720	200.9	25.3	175.6	1.5	61.2
10/06/91	74	69994	3830	203.7	28.6	175.1	1.7	64.4
03/06/92	74	70146	3930	199.2	23.6	175.6	1.3	62.8
06/07/92	74	70239	3990	186.1	8.8	177.1	0.7	51.7
07/26/93	74	70653	4260	235.0	41.6	193.4	2.2	70.3
07/26/93	74	70653	4260	218.2	37.1	181.4	2.4	68.9
07/26/93	74	70653	4260	224.8	41.6	183.1	2.2	70.3

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
06/03/86	78	68043	2550	280.2	72.2	207.9	3.5	80.8
01/04/90	78	69354	3410	186.1	13.0	173.1	0.7	53.1
03/27/90	78	69436	3460	201.9	19.6	182.4	1.0	58.2
08/14/90	78	69576	3560	211.2	35.6	175.6	2.1	67.1
09/13/90	78	69606	3580	199.9	24.3	175.6	2.0	59.3
10/18/90	78	69641	3600	193.6	18.6	175.3	1.8	59.7
11/07/90	78	69661	3610	182.1	9.0	173.1	0.5	50.4
01/19/91	78	69734	3660	190.1	16.6	173.8	0.9	60.0
01/30/91	78	69745	3660	183.9	19.1	164.6	0.8	59.0
02/15/91	78	69761	3680	191.9	16.6	175.3	1.9	57.9
03/23/91	78	69797	3700	197.7	22.1	175.6	2.0	60.6
04/27/91	78	69832	3720	200.2	25.3	174.8	1.8	63.3
05/25/91	78	69860	3740	201.9	27.6	174.3	1.5	64.7
06/29/91	78	69895	3760	196.4	21.6	174.8	1.8	61.0
07/27/91	78	69923	3780	196.4	23.3	173.1	2.2	60.2
08/22/91	78	69949	3800	211.2	38.1	172.8	2.0	70.3
09/19/91	78	69977	3820	179.6	7.8	171.6	0.7	52.3
10/06/91	78	69994	3830	204.4	29.3	175.1	1.6	64.4
10/15/91	78	70003	3840	196.4	24.8	171.6	1.4	65.2
10/28/91	78	70016	3851	196.2	25.6	170.8	1.4	66.4
11/17/91	78	70036	3860	193.4	33.1	160.3	1.5	67.0
11/18/91	78	70037	3860	200.9	29.8	171.1	1.7	65.9
12/15/91	78	70064	3880	186.1	16.3	170.1	0.9	57.3
01/17/92	78	70097	3900	191.1	18.6	172.3	1.3	59.3
02/27/92	78	70138	3920	195.9	23.6	172.6	1.3	63.5
03/06/92	78	70146	3930	187.4	29.8	157.5	1.6	66.1
03/27/92	78	70167	3940	179.6	8.0	171.6	0.7	53.0
04/15/92	78	70186	3960	181.4	10.0	171.3	0.5	50.7
05/14/92	78	70215	3970	181.6	9.5	171.8	-0.3	47.5
06/03/92	78	70235	3990	161.8	10.5	151.3	0.6	52.7
06/10/92	78	70242	3990	185.4	11.8	173.3	0.5	50.5
07/28/92	78	70290	4020	207.4	31.9	175.6	2.0	66.4
08/25/92	78	70318	4042	214.0	38.6	175.6	2.0	68.7
09/07/92	78	70331	4050	201.2	27.1	174.1	1.9	61.7
09/23/92	78	70347	4060	182.1	11.3	170.8	-0.7	47.5
10/19/92	78	70373	4080	182.1	10.3	171.8	-0.4	47.5
11/08/92	78	70393	4090	182.9	10.8	172.1	0.7	52.8
12/18/92	78	70433	4120	178.8	2.3	176.6	-0.9	47.5
01/21/93	78	70467	4140	176.6	0.0	176.6	-1.0	47.5
02/17/93	78	70494	4160	183.1	5.3	177.6	0.2	47.5
03/20/93	78	70525	4180	177.8	0.5	177.1	0.0	47.5
04/22/93	78	70558	4200	210.2	30.4	180.1	1.9	66.5
05/20/93	78	70586	4220	201.9	22.3	179.6	1.7	61.8
06/16/93	78	70613	4240	213.0	32.6	180.6	2.3	66.8
07/14/93	78	70641	4260	213.2	33.1	180.1	2.2	65.0
07/25/93	78	70652	4260	181.6	33.1	148.5	2.0	65.9
07/25/93	78	70652	4260	181.6	33.1	148.5	2.0	65.9
08/17/93	78	70675	4280	203.4	24.3	179.1	1.5	64.5
08/30/93	78	70688	4290	194.2	15.8	178.3	1.0	55.8
09/13/93	78	70702	4300	203.2	23.8	179.4	1.6	63.3
10/11/93	78	70730	4320	192.1	14.0	178.1	0.9	54.7
11/07/93	78	70757	4330	187.1	10.0	177.3	0.8	53.1
12/17/93	78	70797	4360	196.2	17.8	178.3	1.1	59.2
01/28/94	78	70839	4380	190.1	12.5	177.6	0.5	51.0
02/23/94	78	70865	4400	201.2	22.8	178.3	1.4	62.0
03/26/94	78	70896	4420	201.4	23.6	177.8	1.2	60.9
04/22/94	78	70923	4440	212.0	33.6	178.1	1.4	69.2
05/26/94	78	70957	4460	192.6	15.6	177.1	0.6	50.8
06/18/94	78	70980	4480	220.0	41.6	178.3	1.5	71.2
07/06/94	78	70998	4490	230.0	51.7	178.3	1.6	77.3
08/21/94	78	71044	4520	216.2	37.1	179.1	1.9	69.4
09/05/94	78	71059	4530	202.4	24.6	177.8	1.2	55.0
10/03/94	78	71087	4550	199.9	21.6	178.3	1.3	60.9
10/30/94	78	71114	4570	188.9	11.0	177.8	1.1	54.8
11/15/94	78	71130	4580	183.9	6.5	177.3	0.7	51.2
01/12/95	78	71188	4610	195.4	17.8	177.6	0.9	53.9
02/11/95	78	71218	4630	188.1	13.0	175.1	1.2	56.9

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
03/20/95	78	71255	4660	193.1	18.3	174.8	1.1	56.6
04/13/95	78	71279	4670	189.6	14.8	174.6	0.9	54.6
05/11/95	78	71307	4690	193.4	17.8	175.3	1.2	54.7
06/07/95	78	71334	4710	198.4	22.1	176.3	1.6	60.8
07/23/95	78	71380	4740	186.9	11.5	175.3	0.9	56.5
08/18/95	78	71406	4760	174.8	0.0	174.8	-0.9	47.5
09/18/95	78	71437	4780	183.9	6.5	177.3	1.2	53.2

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
08/13/90	87	69575	3560	222.7	32.9	189.9	2.0	65.1
09/13/90	87	69606	3580	219.7	29.8	189.9	1.7	63.6
10/18/90	87	69641	3600	221.0	31.1	189.9	1.9	66.1
11/07/90	87	69661	3610	196.7	6.8	189.9	0.6	51.4
01/19/91	87	69734	3660	210.0	20.1	189.9	3.1	62.0
02/15/91	87	69761	3680	218.0	28.1	189.9	2.0	64.2
03/23/91	87	69797	3700	215.7	25.8	189.9	2.0	63.5
04/27/91	87	69832	3720	215.7	25.8	189.9	1.5	64.0
05/25/91	87	69860	3740	214.5	24.6	189.9	1.4	64.3
06/29/91	87	69895	3760	215.7	25.8	189.9	1.6	64.3
07/27/91	87	69923	3780	221.7	33.1	188.6	1.8	67.2
08/22/91	87	69949	3800	225.5	36.9	188.6	2.0	69.8
10/15/91	87	70003	3840	223.0	33.4	189.6	1.9	67.6
10/28/91	87	70016	3851	205.9	15.8	190.1	0.6	54.1
11/11/91	87	70030	3852	210.2	20.1	190.1	1.0	55.2
11/18/91	87	70037	3860	214.2	24.1	190.1	1.4	63.7
12/15/91	87	70064	3880	203.7	13.5	190.1	0.9	55.8
01/17/92	87	70097	3900	208.7	19.1	189.6	1.1	61.6
02/27/92	87	70138	3920	214.2	24.6	189.6	1.6	63.9
03/27/92	87	70167	3940	201.7	12.0	189.6	1.2	56.6
04/15/92	87	70186	3960	205.9	16.3	189.6	1.2	57.3
05/14/92	87	70215	3970	211.2	20.1	191.1	1.2	55.0
06/10/92	87	70242	3990	217.0	25.8	191.1	1.3	63.4
06/30/92	87	70262	4010	179.9	26.8	153.0	1.9	63.3
07/28/92	87	70290	4020	231.8	40.6	191.1	1.6	71.6
08/25/92	87	70318	4042	230.5	39.9	190.6	1.7	70.2
09/07/92	87	70331	4050	218.2	28.1	190.1	1.7	62.8
09/23/92	87	70347	4060	190.4	0.3	190.1	-1.4	49.1
10/19/92	87	70373	4080	191.1	1.0	190.1	-0.2	49.1
11/08/92	87	70393	4090	206.7	16.6	190.1	1.5	58.9
12/18/92	87	70433	4120	190.4	0.0	190.4	-0.9	49.1
01/21/93	87	70467	4140	214.5	24.1	190.4	1.7	63.9
02/17/93	87	70494	4160	212.7	22.3	190.4	1.8	61.4
03/20/93	87	70525	4180	203.2	13.3	189.9	3.0	56.7
04/22/93	87	70558	4200	224.3	34.4	189.9	1.6	68.9
05/20/93	87	70586	4220	224.8	34.6	189.9	2.0	67.8
06/16/93	87	70613	4240	226.8	36.9	189.9	2.1	68.7
07/14/93	87	70641	4260	226.5	36.9	189.6	3.5	68.0
08/17/93	87	70675	4280	215.7	27.1	188.6	2.0	63.5
08/30/93	87	70688	4290	217.0	27.3	189.6	3.5	64.5
08/30/93	87	70688	4300	217.0	27.3	189.6	3.5	64.5
10/11/93	87	70730	4320	201.9	12.5	189.6	3.5	55.4
11/07/93	87	70757	4330	201.2	12.5	188.4	1.2	55.4
12/17/93	87	70797	4360	211.2	21.8	189.6	3.5	62.1
01/28/94	87	70839	4380	203.9	14.3	189.6	3.5	53.9
02/23/94	87	70865	4400	209.5	21.6	187.9	1.4	61.7
03/26/94	87	70896	4420	204.7	16.8	187.9	1.4	57.6
04/22/94	87	70923	4440	213.2	25.3	187.9	3.0	63.3
05/26/94	87	70957	4460	209.7	21.8	187.9	1.3	60.8
06/18/94	87	70980	4480	227.5	39.1	188.1	1.4	69.7
07/06/94	87	70998	4490	233.0	44.6	188.1	1.6	74.0
08/21/94	87	71044	4520	223.5	35.4	188.1	1.9	68.0
09/05/94	87	71059	4530	206.9	18.8	188.1	1.3	56.2
10/03/94	87	71087	4550	214.7	26.3	188.4	1.4	64.3
10/30/94	87	71114	4570	217.7	29.3	188.4	2.1	64.5
11/15/94	87	71130	4580	194.2	5.8	188.4	0.7	51.6
01/12/95	87	71188	4610	208.9	20.6	188.4	1.2	62.4
02/11/95	87	71218	4630	203.4	16.6	186.9	1.2	58.1
03/20/95	87	71255	4660	207.2	20.3	186.9	1.2	59.3
04/13/95	87	71279	4670	203.9	17.1	186.9	1.6	57.8
05/11/95	87	71307	4690	207.7	20.8	186.9	1.5	61.4
06/07/95	87	71334	4710	201.9	16.6	185.4	1.3	59.3
07/23/95	87	71380	4740	204.9	19.6	185.4	1.5	61.1
08/18/95	87	71406	4760	197.4	12.0	185.4	1.0	55.3
09/18/95	87	71437	4780	215.0	29.6	185.4	2.0	65.5

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
08/14/90	103	69576	3560	284.7	87.5	197.2	2.5	88.5
09/13/90	103	69606	3580	277.2	76.0	201.4	2.5	80.6
10/18/90	103	69641	3600	273.7	75.5	198.2	2.6	80.3
11/07/90	103	69661	3610	249.6	53.4	195.9	2.3	75.3
01/19/91	103	69734	3660	263.1	64.0	199.2	2.6	82.8
03/24/91	103	69798	3700	254.1	54.4	199.7	2.3	74.9
04/27/91	103	69832	3720	247.8	57.7	190.1	1.9	77.3
05/25/91	103	69860	3740	260.9	61.5	199.7	2.1	81.3
06/29/91	103	69895	3760	263.6	63.0	200.7	2.3	80.7
07/27/91	103	69923	3780	284.5	83.3	201.2	2.3	88.3
08/22/91	103	69949	3800	269.9	71.0	198.9	2.4	82.8
09/19/91	103	69977	3820	262.1	68.5	193.6	2.6	81.0
10/15/91	103	70003	3840	263.1	65.5	197.7	2.7	79.6
10/29/91	103	70017	3851	255.9	52.9	202.9	2.4	76.9
11/18/91	103	70037	3860	235.8	41.9	193.9	1.6	71.9
12/15/91	103	70064	3880	236.0	42.1	193.9	1.8	70.0
01/17/92	103	70097	3900	258.1	58.7	199.4	2.2	79.6
02/27/92	103	70138	3920	246.3	46.2	200.2	2.1	74.5
03/27/92	103	70167	3940	246.8	45.4	201.4	2.2	74.0
04/15/92	103	70186	3960	260.4	58.2	202.2	2.3	79.1
05/14/92	103	70215	3970	258.1	60.0	198.2	2.0	80.7
07/28/92	103	70290	4020	272.2	73.2	198.7	2.1	83.4
08/25/92	103	70318	4042	264.6	69.2	195.7	2.1	82.3
09/07/92	103	70331	4050	261.6	65.0	196.7	2.2	78.3
09/23/92	103	70347	4060	241.8	48.7	193.1	2.0	74.6
10/19/92	103	70373	4080	265.9	70.2	195.7	2.4	82.0
11/08/92	103	70393	4090	263.4	69.5	194.2	2.2	80.7
12/13/92	103	70428	4120	244.3	58.9	185.4	1.7	82.8
01/21/93	103	70467	4140	248.3	55.9	192.4	2.0	78.5
02/17/93	103	70494	4160	227.8	35.9	191.6	2.2	65.6
03/20/93	103	70525	4180	223.7	34.1	189.6	2.0	65.2
04/22/93	103	70558	4200	247.1	58.9	188.1	2.0	79.7
05/20/93	103	70586	4220	271.2	62.2	209.2	3.5	74.9
06/16/93	103	70613	4240	276.9	65.0	211.7	3.4	76.6
07/14/93	103	70641	4260	272.7	62.7	210.2	3.3	74.3
08/17/93	103	70675	4280	264.9	57.4	207.4	3.1	74.7
08/30/93	103	70688	4290	272.2	65.0	207.2	3.2	77.7
09/13/93	103	70702	4300	282.7	76.0	206.7	3.1	80.7
10/11/93	103	70730	4320	259.6	51.4	208.2	3.4	73.3
11/07/93	103	70757	4330	248.1	46.2	202.2	3.2	70.2
12/17/93	103	70797	4360	252.6	48.2	204.2	1.8	78.5
01/28/94	103	70839	4380	250.6	50.2	200.4	2.0	78.3
02/23/94	103	70865	4400	252.3	47.4	204.9	2.1	75.2
03/26/94	103	70896	4420	256.1	54.4	201.7	2.2	77.0
04/22/94	103	70923	4440	260.6	60.5	200.4	2.1	79.5
05/26/94	103	70957	4460	250.8	51.2	199.7	2.0	77.1
06/18/94	103	70980	4480	255.6	55.9	199.4	2.0	78.0
07/06/94	103	70998	4490	271.4	69.7	201.7	2.1	83.1
08/21/94	103	71044	4520	253.9	53.2	200.9	2.2	76.9
09/05/94	103	71059	4530	249.3	50.7	198.9	2.0	76.1
10/03/94	103	71087	4550	252.1	50.9	200.9	2.2	76.0
10/30/94	103	71114	4570	260.1	57.7	202.7	2.0	82.6
11/15/94	103	71130	4580	254.1	60.0	193.9	2.1	79.3
01/12/95	103	71188	4610	259.9	60.7	199.2	2.0	80.7
02/11/95	103	71218	4630	239.8	42.9	197.2	1.9	72.2
03/20/95	103	71255	4660	248.6	55.9	192.6	2.0	79.9
04/13/95	103	71279	4670	263.1	63.2	199.9	2.3	81.7
05/11/95	103	71307	4690	247.1	47.4	199.7	2.0	73.0
06/07/95	103	71334	4710	238.8	42.9	195.9	2.0	71.7
07/23/95	103	71380	4740	238.3	44.9	193.6	2.1	73.3
08/18/95	103	71406	4760	249.6	48.7	200.9	2.6	72.8
09/18/95	103	71437	4780	213.7	19.6	193.9	1.8	60.4

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
10/09/80	107	65980	1190	286.5	92.6	193.9	4.5	84.1
01/15/81	107	66078	1250	268.1	57.9	210.0	5.7	69.5
04/12/81	107	66165	1310	297.2	90.3	206.9	5.5	88.7
07/14/81	107	66258	1370	317.6	110.1	207.4	5.2	95.7
10/20/81	107	66356	1440	303.0	92.6	210.5	5.7	85.7
01/08/82	107	66436	1490	317.3	99.8	217.5	5.7	88.1
04/08/82	107	66526	1550	304.8	93.1	211.7	5.5	85.7
07/16/82	107	66625	1610	299.8	95.1	204.7	4.6	86.0
01/09/83	107	66802	1730	303.3	93.3	210.0	5.3	84.2
04/28/83	107	66911	1800	291.7	83.8	207.9	5.3	83.8
07/12/83	107	66986	1850	293.7	88.3	205.4	5.1	83.7
10/27/83	107	67093	1920	313.3	97.6	216.0	4.7	87.4
01/08/84	107	67166	1970	303.8	96.6	207.2	4.8	87.0
07/10/84	107	67350	2090	343.9	118.6	225.3	5.7	97.5
10/08/84	107	67440	2150	342.6	119.4	223.2	5.9	94.5
01/29/85	107	67553	2220	327.1	101.8	225.3	5.7	89.3
04/04/85	107	67618	2270	331.6	106.1	225.5	5.5	92.0
07/08/85	107	67713	2330	339.1	109.6	229.8	5.5	89.4

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
08/14/90	118	69576	3560	299.8	72.5	227.3	2.5	82.2
09/13/90	118	69606	3580	296.0	68.0	228.0	2.6	78.9
10/17/90	118	69640	3600	299.0	70.2	228.8	2.5	83.5
11/07/90	118	69661	3610	319.8	86.3	233.5	2.8	87.9
01/19/91	118	69734	3660	287.7	54.2	233.5	2.3	80.1
03/24/91	118	69798	3700	242.1	21.3	220.7	1.7	61.1
04/27/91	118	69832	3720	264.1	40.9	223.2	1.6	72.0
05/25/91	118	69860	3740	264.9	42.6	222.2	1.9	72.9
06/29/91	118	69895	3760	269.7	43.6	226.0	2.0	71.6
07/27/91	118	69923	3780	272.9	47.9	225.0	2.1	73.0
08/22/91	118	69949	3800	279.2	59.2	220.0	2.3	78.2
09/19/91	118	69977	3820	278.7	53.4	225.3	2.3	80.0
10/15/91	118	70003	3840	272.4	45.4	227.0	2.3	74.0
10/28/91	118	70016	3851	261.4	41.6	219.5	1.9	73.6
11/18/91	118	70037	3860	261.6	46.2	215.5	1.8	74.6
12/15/91	118	70064	3880	239.3	25.8	213.7	1.7	61.2
01/17/92	118	70097	3900	255.9	40.1	215.7	1.7	75.4
02/27/92	118	70138	3920	246.1	29.1	217.0	1.6	66.7
03/27/92	118	70167	3940	256.6	37.1	219.5	1.8	71.0
04/15/92	118	70186	3960	265.6	43.6	222.2	2.0	72.3
05/14/92	118	70215	3970	260.1	44.4	215.7	1.7	73.5
06/10/92	118	70242	3990	271.4	52.4	219.2	2.1	74.3
07/28/92	118	70290	4020	262.4	43.6	218.7	2.1	71.4
08/25/92	118	70318	4042	234.5	21.3	213.2	1.3	59.5
09/07/92	118	70331	4050	233.0	20.6	212.7	1.4	59.4
09/23/92	118	70347	4060	235.0	28.1	206.9	1.5	66.1
10/19/92	118	70373	4080	232.0	25.3	206.4	1.6	62.5
11/08/92	118	70393	4090	231.3	24.6	206.7	1.6	62.0
12/13/92	118	70428	4120	198.9	21.3	177.8	1.0	61.2
01/21/93	118	70467	4140	232.5	38.1	194.4	1.6	71.0
02/17/93	118	70494	4160	207.7	27.1	180.6	1.7	63.5
03/20/93	118	70525	4180	206.9	17.1	189.9	1.0	56.0
04/22/93	118	70558	4200	215.2	27.3	188.1	1.9	62.7
05/20/93	118	70586	4220	157.5	13.5	144.0	0.9	57.3
06/16/93	118	70613	4240	252.6	40.1	212.5	2.6	68.6
07/14/93	118	70641	4260	211.2	21.6	189.6	1.8	61.4
08/17/93	118	70675	4280	234.5	29.3	205.2	1.8	64.4
08/30/93	118	70688	4290	226.3	27.8	198.4	1.5	65.2
09/13/93	118	70702	4300	229.8	26.1	203.7	1.8	63.8
10/11/93	118	70730	4320	214.5	20.8	193.6	1.2	57.9
11/07/93	118	70757	4330	226.3	28.8	197.4	2.0	64.8
12/17/93	118	70797	4360	243.6	44.9	198.7	1.8	78.0
01/28/94	118	70839	4380	235.8	37.1	198.9	1.7	71.9
02/23/94	118	70865	4400	245.1	45.2	199.9	1.9	73.7
03/26/94	118	70896	4420	235.0	36.4	198.4	1.8	70.4
04/22/94	118	70923	4440	235.0	40.6	194.4	1.7	73.1
05/26/94	118	70957	4460	242.8	35.4	207.4	1.9	68.5
06/18/94	118	70980	4480	243.3	34.4	209.2	2.0	67.5
07/06/94	118	70998	4490	249.8	35.1	214.7	2.2	66.8
08/21/94	118	71044	4520	250.3	38.6	211.7	2.1	69.2
09/05/94	118	71059	4530	243.3	34.6	208.7	1.6	69.5
10/03/94	118	71087	4550	242.1	34.1	207.9	1.6	68.2
10/30/94	118	71114	4570	240.1	31.4	208.7	1.6	64.9
11/15/94	118	71130	4580	237.5	37.4	200.2	1.6	70.8
01/12/95	118	71188	4610	238.0	35.6	202.2	1.9	68.9
02/11/95	118	71218	4630	230.5	34.6	196.2	1.6	69.3
03/20/95	118	71255	4660	257.1	43.4	213.7	2.4	70.1
04/13/95	118	71279	4670	253.6	34.6	219.0	2.0	68.5
05/11/95	118	71307	4690	251.3	35.9	215.5	1.7	68.0
06/07/95	118	71334	4710	271.7	48.2	223.5	2.6	73.4
07/23/95	118	71380	4740	263.4	41.1	222.0	2.0	68.6
08/18/95	118	71406	4760	270.4	50.7	220.0	2.4	76.5
09/18/95	118	71437	4780	265.6	35.9	229.8	2.2	68.4

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
06/03/85	131	67678	2310	223.7	38.6	185.1	1.9	68.1
07/02/85	131	67707	2330	220.0	33.4	186.4	1.7	68.5
07/31/85	131	67736	2340	226.5	38.4	188.1	2.1	67.5
09/29/85	131	67796	2390	236.3	41.4	194.9	2.0	70.3
11/10/85	131	67838	2410	229.3	35.9	193.4	1.7	68.9
11/30/85	131	67858	2430	228.5	33.6	194.9	1.8	66.7
12/28/85	131	67886	2440	228.5	36.6	191.9	1.6	69.2
02/09/87	131	68294	2710	205.7	25.8	179.9	1.3	62.0
03/07/87	131	68320	2730	193.6	17.6	176.1	1.2	58.5
04/02/87	131	68346	2740	200.9	25.8	175.3	1.3	65.2
04/30/87	131	68374	2760	209.5	28.3	181.1	1.6	66.0
05/28/87	131	68402	2780	224.0	26.1	197.9	1.4	65.4
06/25/87	131	68430	2800	232.5	29.6	202.9	1.6	68.1
01/04/90	131	69354	3410	274.2	50.4	223.7	1.8	77.4
03/24/90	131	69433	3460	272.9	52.4	220.7	1.9	78.0
07/01/90	131	69532	3530	312.8	64.7	247.8	4.2	72.7
01/29/91	131	69744	3660	277.7	47.7	230.0	2.2	74.1
04/26/91	131	69831	3720	268.9	44.6	224.3	2.0	74.0
10/06/91	131	69994	3830	302.8	58.7	244.1	4.4	74.0
03/06/92	131	70146	3930	293.2	59.7	233.3	3.2	77.0
06/02/92	131	70234	3990	297.7	65.2	232.5	2.8	80.5
07/25/93	131	70652	4260	339.9	80.8	259.4	5.0	77.6

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
10/09/80	135	65980	1190	207.7	22.1	185.6	1.4	63.7
01/15/81	135	66078	1250	178.1	7.0	170.8	0.5	50.7
04/10/81	135	66163	1310	198.2	22.8	175.3	1.3	63.3
07/14/81	135	66258	1370	183.6	13.5	170.1	1.1	56.8
10/20/81	135	66356	1440	191.9	18.3	173.6	1.4	60.0
01/08/82	135	66436	1490	195.9	23.3	172.6	1.5	63.2
04/08/82	135	66526	1550	200.2	22.8	177.3	1.4	62.0
07/16/82	135	66625	1610	212.7	23.1	189.6	2.0	61.6
01/09/83	135	66802	1730	196.7	22.3	174.3	1.4	62.5
04/28/83	135	66911	1800	199.2	19.1	179.9	1.4	60.6
07/12/83	135	66986	1850	202.4	22.6	179.9	1.4	62.3
10/27/83	135	67093	1920	192.4	17.1	175.6	1.3	59.2
01/08/84	135	67166	1970	197.2	20.1	177.1	1.6	60.2
07/10/84	135	67350	2090	205.4	13.8	191.6	1.1	57.0
10/08/84	135	67440	2150	217.7	24.3	193.4	1.6	65.9
01/29/85	135	67553	2220	204.2	24.1	179.9	1.3	64.9
04/04/85	135	67618	2270	217.2	28.8	188.4	1.6	65.5
11/12/85	135	67840	2410	214.5	28.1	186.1	1.8	64.4
07/09/86	135	68079	2570	205.7	14.0	191.6	1.4	56.4
09/29/86	135	68161	2630	212.7	27.3	185.6	1.4	64.4
01/09/87	135	68263	2690	192.1	21.3	170.8	0.8	60.0
05/08/87	135	68382	2770	218.7	28.1	190.6	1.7	65.5
07/09/87	135	68444	2810	222.2	27.1	195.2	2.0	63.9
09/16/88	135	68879	3100	245.8	32.9	213.2	1.6	66.7
01/12/89	135	68997	3170	241.1	27.6	213.5	1.5	64.3
07/10/89	135	69176	3290	252.6	34.9	217.7	1.8	68.4
01/04/90	135	69354	3410	253.1	35.1	218.0	1.6	70.2
03/24/90	135	69433	3460	264.6	34.9	229.8	1.7	69.0
07/02/90	135	69533	3530	271.2	36.4	234.8	2.0	67.1
08/14/90	135	69576	3560	287.0	51.4	235.3	2.1	74.4
09/13/90	135	69606	3580	283.4	49.4	234.3	2.3	71.6
10/17/90	135	69640	3600	285.2	47.7	237.5	2.3	71.2
11/07/90	135	69661	3610	281.7	39.4	242.3	2.0	69.5
01/19/91	135	69734	3660	288.5	33.6	254.6	1.7	68.9
01/29/91	135	69744	3660	288.0	39.4	248.6	1.6	71.5
02/15/91	135	69761	3680	301.3	41.9	259.4	2.5	71.7
03/24/91	135	69798	3700	306.0	48.7	257.4	2.2	74.5
04/17/91	135	69822	3720	287.7	37.1	250.6	2.0	68.4
04/27/91	135	69832	3720	294.7	39.1	255.6	1.7	70.4
05/25/91	135	69860	3740	304.5	44.4	260.1	1.9	75.3
06/29/91	135	69895	3760	307.0	47.7	259.4	2.0	74.3
07/27/91	135	69923	3780	272.7	25.1	247.6	1.6	62.1
10/05/91	135	69993	3830	300.3	47.4	252.8	2.1	73.5
10/15/91	135	70003	3840	300.0	45.2	254.9	2.2	74.7
10/29/91	135	70017	3851	292.0	37.9	254.1	1.8	71.9
11/11/91	135	70030	3852	276.9	36.6	240.3	1.6	71.6
11/17/91	135	70036	3860	285.7	38.9	246.8	1.7	71.3
11/18/91	135	70037	3860	276.4	34.4	242.1	1.6	69.0
12/15/91	135	70064	3880	267.6	27.1	240.6	1.6	65.5
01/17/92	135	70097	3900	279.9	37.6	242.6	1.7	70.9
02/27/92	135	70138	3920	293.7	38.6	255.4	2.0	71.6
03/06/92	135	70146	3930	292.7	38.1	254.6	2.0	70.1
03/27/92	135	70167	3940	314.6	55.2	259.4	2.3	79.6
04/15/92	135	70186	3960	310.0	48.9	261.1	2.2	74.4
05/14/92	135	70215	3970	309.5	46.7	262.9	2.1	75.0
06/02/92	135	70234	3990	298.2	40.4	257.9	2.0	70.0
06/10/92	135	70242	3990	304.0	44.9	259.1	2.1	71.8
06/30/92	135	70262	4010	301.5	48.2	253.3	2.1	72.4
07/28/92	135	70290	4020	322.1	61.7	260.4	2.4	79.7
08/25/92	135	70318	4042	326.3	70.2	256.1	2.3	83.5
09/07/92	135	70331	4050	325.6	71.7	253.6	2.2	83.0
09/23/92	135	70347	4060	307.8	46.2	261.6	2.0	74.7
10/19/92	135	70373	4080	311.5	46.2	265.4	2.1	71.9
11/08/92	135	70393	4090	301.8	36.1	265.9	2.3	68.1
12/13/92	135	70428	4120	308.5	47.9	260.4	1.8	76.9
01/21/93	135	70467	4140	294.0	40.1	253.9	1.8	67.3
02/17/93	135	70494	4160	300.5	36.1	264.4	2.1	66.2

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
03/20/93	135	70525	4180	294.0	29.8	264.1	1.9	64.8
04/22/93	135	70558	4200	323.3	55.2	268.1	2.2	76.4
05/20/93	135	70586	4220	316.8	47.4	269.4	2.2	72.2
06/16/93	135	70613	4240	310.8	46.7	264.1	2.2	71.1
07/14/93	135	70641	4260	315.3	56.4	258.9	2.3	76.1
07/25/93	135	70652	4260	308.5	55.4	253.1	2.2	76.4
08/17/93	135	70675	4280	301.0	49.4	251.3	2.3	70.3
08/30/93	135	70688	4290	296.7	43.6	253.1	2.2	71.7
09/13/93	135	70702	4300	299.0	44.1	254.9	2.2	71.3
10/11/93	135	70730	4320	293.0	36.9	256.1	2.1	69.6
11/07/93	135	70757	4330	297.7	36.4	261.4	2.3	67.3
12/17/93	135	70797	4360	311.3	52.7	258.6	2.0	78.9
01/28/94	135	70839	4380	308.8	45.4	263.4	2.0	72.5
02/23/94	135	70865	4400	312.3	47.4	264.9	2.0	75.2
03/26/94	135	70896	4420	356.7	82.5	274.2	3.2	85.6
04/22/94	135	70923	4440	304.0	40.9	263.4	2.0	70.8
05/26/94	135	70957	4460	299.8	34.1	265.6	2.0	67.6
06/18/94	135	70980	4480	304.5	39.9	264.6	2.4	67.9
07/06/94	135	70998	4490	318.3	47.7	270.7	2.6	76.0
08/21/94	135	71044	4520	296.7	34.9	262.1	2.2	67.6
09/05/94	135	71059	4530	299.8	32.1	267.6	1.6	68.4
10/03/94	135	71087	4550	301.0	32.4	268.4	1.7	62.0
10/30/94	135	71114	4570	273.4	21.8	251.6	1.3	62.1
11/15/94	135	71130	4580	287.0	23.8	263.4	1.4	61.9
01/12/95	135	71188	4610	309.8	34.9	274.9	1.9	68.4
02/11/95	135	71218	4630	290.5	31.6	258.9	1.6	68.2
03/20/95	135	71255	4660	314.1	42.9	271.2	2.1	71.4
04/13/95	135	71279	4670	299.8	33.4	266.6	2.0	68.4
05/11/95	135	71307	4690	332.4	41.6	290.7	4.2	65.7
06/07/95	135	71334	4710	307.8	43.9	263.9	1.9	74.7
07/23/95	135	71380	4740	347.2	64.2	283.2	3.1	80.3
08/18/95	135	71406	4760	311.3	42.1	269.2	2.4	70.9
09/18/95	135	71437	4780	353.4	85.0	268.4	2.7	82.7

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
08/13/90	148	69575	3560	171.1	61.7	109.4	3.9	55.9
10/17/90	148	69640	3600	183.6	74.0	109.4	2.3	62.5
11/07/90	148	69661	3610	172.3	63.0	109.4	2.1	58.8
01/19/91	148	69734	3660	163.3	53.7	109.4	3.9	57.6
02/15/91	148	69761	3680	160.0	50.7	109.4	2.2	52.7
03/23/91	148	69797	3700	161.8	52.2	109.4	3.9	52.1
04/27/91	148	69832	3720	158.0	48.7	109.4	3.9	53.0
05/25/91	148	69860	3740	163.5	54.4	109.1	3.7	56.8
06/29/91	148	69895	3760	165.1	55.7	109.4	3.9	56.3
07/27/91	148	69923	3780	167.3	57.9	109.4	3.9	54.4
08/22/91	148	69949	3800	170.8	61.5	109.4	3.9	58.6
09/19/91	148	69977	3820	161.0	51.7	109.4	3.9	50.3
10/15/91	148	70003	3840	170.6	61.2	109.4	3.9	59.8
10/28/91	148	70016	3851	149.0	39.6	109.4	3.9	50.0
11/18/91	148	70037	3860	155.3	45.9	109.4	3.9	52.7
12/15/91	148	70064	3880	147.2	37.9	109.4	3.9	44.4
01/17/92	148	70097	3900	149.8	39.4	110.4	3.9	49.3
02/27/92	148	70138	3920	150.3	39.6	110.4	3.9	50.0
03/27/92	148	70167	3940	138.7	28.3	110.4	3.9	42.5
04/15/92	148	70186	3960	142.7	32.4	110.4	3.9	43.6
05/14/92	148	70215	3970	154.0	43.6	110.4	1.7	52.2
06/10/92	148	70242	3990	157.0	46.7	110.4	3.9	51.0
07/28/92	148	70290	4020	162.5	52.2	110.4	3.9	52.7
08/25/92	148	70318	4042	164.8	54.4	110.4	3.9	53.4
09/07/92	148	70331	4050	169.3	58.9	110.1	2.3	54.6
09/23/92	148	70347	4060	155.0	44.9	110.1	2.0	51.8
10/19/92	148	70373	4080	165.6	55.2	110.1	2.2	54.7
11/08/92	148	70393	4090	160.0	49.7	110.1	2.4	51.0
12/13/92	148	70428	4120	164.6	53.9	110.9	2.0	57.0
01/21/93	148	70467	4140	167.6	56.9	110.9	2.3	57.2
02/17/93	148	70494	4160	159.8	48.9	110.9	2.4	51.6
03/20/93	148	70525	4180	156.5	45.4	111.1	4.0	50.7
04/22/93	148	70558	4200	171.1	60.0	111.1	2.4	57.6
05/20/93	148	70586	4220	165.3	54.2	111.1	2.4	54.3
06/16/93	148	70613	4240	172.1	61.0	111.1	2.4	57.2
07/14/93	148	70641	4260	175.1	64.2	110.9	3.9	56.3
08/17/93	148	70675	4280	167.1	56.2	110.9	3.9	56.3
08/30/93	148	70688	4290	150.8	39.9	110.9	2.1	52.2
09/13/93	148	70702	4300	158.0	47.2	110.9	3.9	51.5
10/11/93	148	70730	4320	167.1	56.2	110.9	3.9	56.1
11/07/93	148	70757	4330	166.1	54.7	111.4	2.3	54.3
12/17/93	148	70797	4360	167.8	56.9	110.9	3.9	57.6
01/28/94	148	70839	4380	173.6	62.5	110.9	3.9	59.3
02/23/94	148	70865	4400	163.3	57.9	105.4	2.3	57.2
03/26/94	148	70896	4420	160.8	55.7	105.4	2.3	54.3
04/22/94	148	70923	4440	159.0	53.7	105.4	2.3	51.1
05/26/94	148	70957	4460	161.3	56.2	105.4	2.3	54.6
06/18/94	148	70980	4480	169.1	57.9	111.4	2.3	54.3
07/06/94	148	70998	4490	172.6	61.5	111.4	2.3	55.4
08/21/94	148	71044	4520	162.0	50.7	111.4	2.3	53.0
09/05/94	148	71059	4530	161.3	49.9	111.4	2.0	52.9
10/03/94	148	71087	4550	162.0	50.7	111.4	2.2	50.1
10/30/94	148	71114	4570	147.7	36.4	111.4	2.3	42.2
11/15/94	148	71130	4580	139.7	28.1	111.4	1.5	41.3
01/12/95	148	71188	4610	168.3	56.9	111.4	2.2	57.1
02/11/95	148	71218	4630	155.3	47.7	107.6	2.2	52.1
03/20/95	148	71255	4660	159.0	51.4	107.6	2.2	56.1
04/13/95	148	71279	4670	164.3	56.4	107.6	2.3	55.2
05/11/95	148	71307	4690	163.3	55.7	107.6	2.3	54.0
06/07/95	148	71334	4710	166.1	56.9	109.1	2.7	53.5
07/23/95	148	71380	4740	134.2	25.1	109.1	1.1	46.4
08/18/95	148	71406	4760	151.3	42.1	109.1	2.4	50.7
09/18/95	148	71437	4780	159.5	50.4	109.1	2.8	52.0

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
10/16/80	161	65987	1200	137.7	45.2	92.6	2.1	50.0
01/15/81	161	66078	1250	112.1	21.3	90.8	1.6	38.2
04/10/81	161	66163	1310	135.2	43.6	91.8	1.7	54.2
07/14/81	161	66258	1370	122.2	31.9	90.3	1.7	45.0
10/20/81	161	66356	1440	130.7	37.4	93.3	2.0	47.6
01/08/82	161	66436	1490	132.7	45.7	87.0	1.9	52.6
05/06/82	161	66554	1570	128.4	41.6	86.8	1.6	52.0
07/16/82	161	66625	1610	135.5	44.6	90.8	2.0	50.1
01/09/83	161	66802	1730	118.9	35.6	83.0	1.6	48.2
04/20/83	161	66903	1800	118.4	34.6	83.8	1.8	44.7
07/12/83	161	66986	1850	119.9	33.9	86.0	2.2	43.5
10/27/83	161	67093	1920	103.8	23.6	80.3	1.6	41.2
01/08/84	161	67166	1970	114.9	33.9	81.0	1.5	45.6
07/10/84	161	67350	2090	100.1	17.6	82.5	1.5	35.8
10/20/84	161	67452	2160	124.4	40.4	84.0	2.1	47.0
01/15/85	161	67539	2210	107.9	26.8	81.3	1.2	46.0
04/23/85	161	67637	2280	119.7	38.9	80.8	1.5	50.1
06/03/85	161	67678	2310	119.4	38.6	80.8	1.7	47.9
07/08/85	161	67713	2330	121.2	38.6	82.3	1.6	47.9
07/31/85	161	67736	2340	123.7	39.9	84.0	1.9	47.7
09/28/85	161	67795	2380	114.9	34.9	80.0	1.6	45.5
11/09/85	161	67837	2400	120.4	36.6	84.0	2.0	47.6
11/10/85	161	67838	2411	118.4	33.4	84.8	2.0	45.7
11/29/85	161	67857	2430	110.9	30.9	80.0	1.5	44.8
12/27/85	161	67885	2440	112.1	32.9	79.0	1.6	45.7
02/18/86	161	67938	2480	105.4	27.3	78.3	1.2	43.9
03/07/86	161	67955	2490	109.1	26.8	82.5	1.6	42.6
04/26/86	161	68005	2520	105.4	25.6	79.8	1.2	42.8
06/03/86	161	68043	2550	107.1	24.1	83.0	1.5	40.5
06/27/86	161	68067	2560	108.9	25.8	83.0	1.6	41.1
07/09/86	161	68079	2570	109.9	27.6	82.3	1.7	41.1
08/11/86	161	68112	2590	112.4	30.6	82.0	1.6	43.9
08/31/86	161	68132	2610	105.6	24.8	80.8	1.9	37.5
09/24/86	161	68156	2620	114.9	34.4	80.5	1.8	45.8
09/29/86	161	68161	2630	117.4	36.6	80.8	1.9	46.5
12/06/86	161	68229	2670	102.6	28.6	74.0	1.4	45.6
01/06/87	161	68260	2690	82.5	18.6	64.0	1.0	38.1
02/09/87	161	68294	2710	89.8	21.1	68.7	0.9	37.5
03/06/87	161	68319	2730	95.8	20.6	75.3	1.3	39.1
04/02/87	161	68346	2740	101.6	23.6	78.0	1.2	39.9
04/30/87	161	68374	2760	100.3	25.1	75.3	1.3	42.4
05/08/87	161	68382	2770	104.3	31.4	73.0	1.3	46.5
05/28/87	161	68402	2780	106.4	27.3	79.0	1.7	43.1
06/25/87	161	68430	2800	105.1	27.3	77.5	1.6	44.8
07/09/87	161	68444	2810	106.1	27.8	78.3	1.9	42.6
08/10/87	161	68476	2830	98.8	22.8	76.0	1.2	40.6
08/24/87	161	68490	2840	106.4	28.8	77.5	2.0	42.9
09/23/87	161	68520	2860	104.6	24.6	80.0	1.9	39.4
02/24/88	161	68674	2960	94.8	20.3	74.5	1.0	40.5
10/21/88	161	68914	3120	106.4	27.3	79.0	1.6	42.1
11/06/88	161	68930	3130	109.1	35.4	73.5	1.4	49.2
11/17/88	161	68941	3140	107.1	31.6	75.5	1.4	44.5
12/03/88	161	68957	3150	110.9	29.1	81.8	1.2	45.4
12/17/88	161	68971	3160	111.6	28.3	83.3	1.4	45.3
01/05/89	161	68990	3170	110.4	25.8	84.5	1.1	40.7
01/19/89	161	69004	3180	111.6	29.8	81.8	1.3	44.9
02/01/89	161	69017	3190	112.9	29.3	83.5	1.4	44.0
02/16/89	161	69032	3200	108.4	25.3	82.8	1.3	40.7
03/11/89	161	69055	3210	90.3	22.6	67.7	1.0	41.5
03/22/89	161	69066	3220	93.8	22.1	71.7	1.2	40.0
04/03/89	161	69078	3230	96.3	25.6	70.7	1.5	42.5
04/17/89	161	69092	3240	91.3	20.3	71.2	1.5	38.3
05/03/89	161	69108	3250	91.1	19.6	71.5	1.4	38.6
05/31/89	161	69136	3270	91.8	18.6	73.5	1.3	38.4
07/24/89	161	69190	3300	98.3	19.1	79.3	1.6	39.3
08/21/89	161	69218	3320	83.5	9.8	74.0	1.0	32.9
09/17/89	161	69245	3340	73.2	9.8	63.5	0.7	31.8

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
07/01/90	161	69532	3530	97.6	20.8	76.8	1.6	38.6
08/14/90	161	69576	3560	119.7	43.9	75.5	2.1	47.4
09/13/90	161	69606	3580	102.8	25.1	77.8	2.2	41.2
10/17/90	161	69640	3600	111.6	34.4	77.3	1.9	46.8
11/07/90	161	69661	3610	92.8	19.1	73.7	1.7	35.5
01/15/91	161	69730	3650	91.6	21.1	70.5	1.1	40.9
01/19/91	161	69734	3660	90.8	24.6	66.2	1.0	43.4
02/15/91	161	69761	3680	97.8	29.3	68.5	1.6	44.5
03/24/91	161	69798	3700	90.6	21.3	69.5	1.4	39.3
04/17/91	161	69822	3720	99.6	24.3	75.0	1.3	41.0
04/27/91	161	69832	3720	94.8	25.3	69.5	1.5	42.8
05/25/91	161	69860	3740	93.8	24.3	69.5	1.3	42.8
06/29/91	161	69895	3760	103.3	31.4	72.2	1.6	45.6
07/27/91	161	69923	3780	99.6	28.3	71.2	1.9	41.5
08/22/91	161	69949	3800	112.9	32.6	80.3	2.0	44.6
09/14/91	161	69972	3820	98.6	20.1	78.5	1.8	36.1
09/19/91	161	69977	3820	94.8	22.8	71.7	1.1	41.5
10/15/91	161	70003	3840	101.6	26.8	74.8	1.4	45.3
10/28/91	161	70016	3851	78.8	20.8	58.2	0.8	37.6
11/17/91	161	70036	3860	94.1	26.8	67.2	1.5	42.8
11/18/91	161	70037	3860	95.6	27.8	67.5	1.6	43.4
12/15/91	161	70064	3880	85.0	19.3	65.7	1.3	36.5
01/17/92	161	70097	3900	100.1	29.3	70.5	1.6	43.9
02/27/92	161	70138	3920	109.1	33.9	75.3	1.6	47.4
03/12/92	161	70152	3930	102.3	23.6	78.8	1.6	40.1
03/27/92	161	70167	3940	111.6	36.1	75.5	1.5	47.8
04/15/92	161	70186	3960	106.6	31.9	74.8	1.6	43.9
05/14/92	161	70215	3970	93.6	25.8	67.7	1.4	42.3
05/30/92	161	70231	3990	91.1	18.6	72.5	1.2	38.1
06/10/92	161	70242	3990	99.3	25.3	74.0	1.6	41.6
07/28/92	161	70290	4020	103.8	28.8	75.0	1.8	43.1
08/25/92	161	70318	4042	106.4	31.4	75.0	1.8	44.8
09/07/92	161	70331	4050	98.8	23.3	75.5	1.7	41.0
09/23/92	161	70347	4060	89.5	21.8	67.7	1.3	40.5
10/19/92	161	70373	4080	96.6	26.1	70.5	1.6	42.3
11/08/92	161	70393	4090	89.3	17.3	71.7	1.4	41.2
12/13/92	161	70428	4120	90.8	25.3	65.2	1.2	41.4
01/21/93	161	70467	4140	98.6	29.3	69.2	1.6	41.7
02/17/93	161	70494	4160	96.6	25.6	71.0	1.3	39.8
03/20/93	161	70525	4180	92.6	21.3	71.2	1.2	40.4
04/18/93	161	70554	4200	106.9	32.1	74.5	1.9	45.4
04/22/93	161	70558	4200	101.8	29.1	72.5	1.5	45.0
05/20/93	161	70586	4220	101.8	27.3	74.5	1.6	43.2
06/16/93	161	70613	4240	106.1	30.9	75.3	1.9	44.0
07/10/93	161	70637	4250	109.9	30.9	78.8	2.0	42.7
07/14/93	161	70641	4260	103.3	28.6	74.8	1.9	41.7
08/17/93	161	70675	4280	103.6	28.6	75.0	1.7	41.0
08/30/93	161	70688	4290	102.8	31.6	71.5	1.3	44.5
09/13/93	161	70702	4300	109.9	35.4	74.8	1.6	46.2
10/11/93	161	70730	4320	96.3	23.8	72.5	1.3	41.2
11/07/93	161	70757	4330	102.3	24.3	78.0	1.8	39.5
12/17/93	161	70797	4360	93.8	26.1	67.7	1.3	43.0
01/28/94	161	70839	4380	89.3	23.1	66.2	1.0	39.3
02/23/94	161	70865	4400	95.1	25.8	69.2	1.3	42.9
03/26/94	161	70896	4420	93.8	23.8	70.2	1.3	41.2
04/22/94	161	70923	4440	84.0	17.6	66.7	1.0	35.7
05/26/94	161	70957	4460	89.0	20.3	68.7	1.3	37.4
06/18/94	161	70980	4480	91.8	21.8	70.0	1.6	39.5
07/06/94	161	70998	4490	95.8	25.1	70.7	1.6	41.8
08/21/94	161	71044	4520	85.0	18.1	67.0	1.0	39.0
09/05/94	161	71059	4530	88.5	19.3	69.0	1.3	39.1
10/03/94	161	71087	4550	84.0	19.3	64.7	0.8	38.0
10/30/94	161	71114	4570	78.0	17.3	60.7	0.7	31.8
11/15/94	161	71130	4580	48.9	9.8	39.1	0.1	15.5
01/12/95	161	71188	4610	68.0	6.5	61.5	1.0	31.2
02/11/95	161	71218	4630	79.8	17.8	62.0	1.1	35.4
03/20/95	161	71255	4660	85.3	20.8	64.5	1.1	39.7

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
04/13/95	161	71279	4670	90.1	19.1	71.0	1.1	39.0
05/11/95	161	71307	4690	92.3	20.8	71.5	1.5	39.1
06/07/95	161	71334	4710	95.6	17.8	77.5	1.7	37.5
07/23/95	161	71380	4740	97.3	13.0	84.3	1.3	34.0
08/18/95	161	71406	4760	83.3	11.5	71.7	1.0	33.0
09/18/95	161	71437	4780	100.6	24.6	75.8	1.5	42.2

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
08/14/90	162	69576	3560	123.2	39.9	83.3	2.2	45.5
09/13/90	162	69606	3580	92.6	12.8	79.5	1.2	35.3
11/07/90	162	69661	3610	98.3	24.1	74.2	1.5	41.8
01/19/91	162	69734	3660	81.3	15.3	66.0	0.9	37.2
03/24/91	162	69798	3700	102.6	22.8	79.8	1.5	40.6
04/27/91	162	69832	3720	93.6	20.8	72.7	1.3	40.0
05/25/91	162	69860	3740	97.8	23.3	74.5	1.4	41.5
07/27/91	162	69923	3780	106.9	28.6	78.3	1.8	43.8
08/22/91	162	69949	3800	112.4	33.9	78.5	1.5	47.1
09/19/91	162	69977	3820	103.1	24.8	78.3	1.2	41.2
10/15/91	162	70003	3840	101.6	23.3	78.3	1.1	42.8
10/28/91	162	70016	3851	88.3	21.1	67.2	0.8	36.8
11/11/91	162	70030	3852	93.1	21.8	71.2	1.2	41.7
11/18/91	162	70037	3860	93.6	22.3	71.2	1.4	41.0
12/15/91	162	70064	3880	85.3	15.8	69.5	0.8	34.9
01/17/92	162	70097	3900	105.1	25.6	79.5	1.5	42.1
02/27/92	162	70138	3920	110.4	29.8	80.5	1.6	44.4
03/27/92	162	70167	3940	115.6	34.4	81.0	1.4	46.9
04/15/92	162	70186	3960	107.4	27.1	80.3	1.4	41.4
05/14/92	162	70215	3970	98.1	25.6	72.5	1.3	42.8
06/10/92	162	70242	3990	99.3	22.3	77.0	1.5	39.5
06/30/92	162	70262	4010	105.1	26.1	79.3	2.0	41.1
07/28/92	162	70290	4020	108.6	26.6	82.0	1.9	41.4
08/25/92	162	70318	4042	106.6	23.8	82.8	1.9	40.7
09/07/92	162	70331	4050	104.6	22.1	82.5	1.6	40.8
09/23/92	162	70347	4060	95.8	18.3	77.3	1.2	38.3
10/19/92	162	70373	4080	103.3	24.3	79.0	1.5	42.1
11/08/92	162	70393	4090	100.8	19.1	82.0	1.5	42.1
12/13/92	162	70428	4120	97.8	22.6	75.0	1.2	39.7
01/21/93	162	70467	4140	91.3	22.6	68.7	1.3	39.3
02/17/93	162	70494	4160	96.1	19.1	77.3	1.1	35.7
03/20/93	162	70525	4180	98.8	18.8	80.0	1.2	37.8
04/22/93	162	70558	4200	106.9	26.1	81.0	1.5	41.8
05/20/93	162	70586	4220	107.9	27.3	80.5	1.6	44.4
06/16/93	162	70613	4240	111.6	30.6	81.0	1.9	42.5
07/14/93	162	70641	4260	105.4	25.6	79.8	2.0	40.6
08/17/93	162	70675	4280	104.9	25.3	79.5	1.4	39.9
08/30/93	162	70688	4290	123.4	40.9	82.3	1.8	47.3
09/13/93	162	70702	4300	117.6	36.9	80.8	1.6	46.0
10/11/93	162	70730	4320	100.1	21.6	78.5	1.3	41.0
11/07/93	162	70757	4330	106.6	24.6	82.0	1.6	41.5
12/17/93	162	70797	4360	102.3	25.3	77.0	1.4	43.3
01/28/94	162	70839	4380	93.3	20.1	73.2	1.0	36.3
02/23/94	162	70865	4400	99.6	22.3	77.3	1.3	40.3
03/26/94	162	70896	4420	100.3	23.3	77.0	1.2	40.3
04/22/94	162	70923	4440	92.8	19.3	73.5	1.0	37.3
05/26/94	162	70957	4460	92.8	18.1	74.8	1.2	38.3
06/18/94	162	70980	4480	94.8	18.6	76.0	1.4	38.3
07/06/94	162	70998	4490	97.8	20.3	77.3	1.5	39.0
08/21/94	162	71044	4520	90.1	15.8	74.2	0.9	35.2
09/05/94	162	71059	4530	92.3	16.1	76.3	1.4	37.2
10/03/94	162	71087	4550	33.1	0.0	33.1	-0.6	16.2
10/30/94	162	71114	4570	85.0	15.8	69.2	0.7	31.7
11/15/94	162	71130	4580	55.7	13.8	41.9	0.5	36.2
01/12/95	162	71188	4610	26.6	0.3	26.6	-0.2	14.3
02/11/95	162	71218	4630	22.3	0.0	22.3	-0.7	10.5
03/20/95	162	71255	4660	82.8	13.0	69.7	1.1	34.4
04/13/95	162	71279	4670	91.1	17.6	73.2	1.3	37.7
05/11/95	162	71307	4690	93.8	19.6	74.2	1.4	38.4
06/07/95	162	71334	4710	103.1	11.5	91.6	1.3	34.4
07/23/95	162	71380	4740	101.3	10.8	90.3	1.1	32.5
08/18/95	162	71406	4760	87.8	9.0	78.8	0.9	31.1
09/18/95	162	71437	4780	91.3	9.8	81.5	1.0	33.1

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
08/13/90	179	69575	3560	107.6	39.6	68.0	2.3	36.4
09/15/90	179	69608	3580	100.3	32.4	68.0	2.4	34.2
10/17/90	179	69640	3600	97.3	35.1	62.2	1.9	37.6
11/07/90	179	69661	3610	91.6	23.6	68.0	1.7	30.6
01/19/91	179	69734	3660	94.8	26.8	68.0	0.7	33.9
03/23/91	179	69797	3700	93.1	25.3	68.0	2.3	29.7
04/27/91	179	69832	3720	97.1	29.1	68.0	1.8	33.2
05/25/91	179	69860	3740	104.6	36.6	68.0	1.6	39.2
06/29/91	179	69895	3760	97.8	30.1	68.0	2.0	33.4
08/22/91	179	69949	3800	103.1	34.6	68.2	2.3	35.3
09/19/91	179	69977	3820	100.6	33.1	67.5	1.6	36.1
10/15/91	179	70003	3840	101.6	34.1	67.5	1.8	37.3
10/28/91	179	70016	3851	85.5	18.3	67.2	0.9	28.2
11/18/91	179	70037	3860	92.8	25.6	67.2	1.7	32.2
12/15/91	179	70064	3880	77.5	10.3	67.2	0.8	20.6
01/17/92	179	70097	3900	91.1	24.3	66.7	1.5	31.8
02/27/92	179	70138	3920	84.3	17.6	66.7	1.2	28.7
03/27/92	179	70167	3940	88.5	21.8	66.7	1.4	29.0
04/15/92	179	70186	3960	89.5	22.8	66.7	1.4	28.4
05/14/92	179	70215	3970	92.6	25.6	67.0	1.7	31.9
06/10/92	179	70242	3990	93.3	26.3	67.0	1.9	31.6
07/28/92	179	70290	4020	96.3	29.3	67.0	2.0	33.1
08/25/92	179	70318	4042	88.3	21.3	67.0	1.8	29.2
09/07/92	179	70331	4050	81.3	13.8	67.7	1.0	24.2
09/23/92	179	70347	4060	87.0	20.3	66.7	1.5	28.3
10/19/92	179	70373	4080	89.5	22.6	67.0	1.5	30.5
11/08/92	179	70393	4090	93.1	26.1	66.7	1.8	31.5
12/13/92	179	70428	4120	83.0	16.6	66.5	1.3	26.5
01/21/93	179	70467	4140	85.3	18.6	66.5	1.1	24.8
02/17/93	179	70494	4160	83.3	16.8	66.5	0.9	24.8
03/20/93	179	70525	4180	79.8	14.0	65.5	1.0	24.4
04/22/93	179	70558	4200	90.3	24.6	65.5	2.0	31.2
05/20/93	179	70586	4220	91.3	25.8	65.5	2.0	31.8
06/16/93	179	70613	4240	88.8	23.1	65.5	1.6	31.4
07/14/93	179	70641	4260	84.8	20.6	64.2	1.7	29.0
08/17/93	179	70675	4280	85.0	20.8	64.2	1.5	30.2
08/30/93	179	70688	4290	83.8	19.6	64.2	1.7	28.5
09/13/93	179	70702	4300	91.3	27.1	64.2	1.7	32.8
10/11/93	179	70730	4320	80.8	16.6	64.2	1.4	28.7
11/07/93	179	70757	4330	86.0	20.6	65.5	1.5	29.0
12/17/93	179	70797	4360	72.0	7.8	64.2	1.3	21.1
01/28/94	179	70839	4380	78.0	13.8	64.2	0.6	20.0
02/23/94	179	70865	4400	83.3	17.3	66.0	1.2	26.9
03/26/94	179	70896	4420	83.3	17.1	66.0	0.9	25.3
04/22/94	179	70923	4440	79.8	13.5	66.0	0.9	21.7
05/26/94	179	70957	4460	80.8	14.8	66.0	1.1	24.5
06/18/94	179	70980	4480	77.0	11.8	65.5	1.3	25.4
07/06/94	179	70998	4490	78.5	13.0	65.5	1.2	24.0
08/21/94	179	71044	4520	79.8	14.3	65.5	0.9	23.3
09/05/94	179	71059	4530	82.5	17.1	65.5	1.5	27.2
10/03/94	179	71087	4550	75.3	9.8	65.5	0.4	17.8
11/15/94	179	71130	4580	64.2	3.5	60.7	2.4	17.4
01/12/95	179	71188	4610	77.0	11.5	65.5	0.9	21.7
02/11/95	179	71218	4630	74.8	13.3	61.7	0.8	24.2
03/20/95	179	71255	4660	75.3	13.8	61.7	1.0	24.6
04/13/95	179	71279	4670	76.0	14.5	61.7	1.1	23.7
05/11/95	179	71307	4690	72.2	10.5	61.7	1.0	22.9
06/07/95	179	71334	4710	67.5	5.0	62.5	1.0	20.4
07/23/95	179	71380	4740	104.6	39.9	64.7	3.7	27.6
08/18/95	179	71406	4760	75.0	11.8	63.2	1.0	24.7
09/18/95	179	71437	4780	63.2	0.0	63.2	-0.6	17.4

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
10/21/88	194	68914	3120	58.7	15.3	43.6	1.3	26.3
11/06/88	194	68930	3130	51.4	10.8	40.9	1.1	23.7
11/17/88	194	68941	3140	47.4	9.3	37.9	0.7	20.7
12/03/88	194	68957	3150	61.0	21.6	39.4	1.4	30.5
12/17/88	194	68971	3160	57.7	21.3	36.4	1.0	30.4
01/05/89	194	68990	3170	57.4	22.1	35.4	0.8	24.5
01/19/89	194	69004	3180	63.0	25.1	37.9	1.1	32.5
02/01/89	194	69017	3190	62.5	24.3	38.1	1.2	31.9
02/16/89	194	69032	3200	54.7	18.3	36.4	0.9	25.2
03/11/89	194	69055	3210	42.4	18.3	24.1	0.6	24.2
03/22/89	194	69066	3220	46.9	18.6	28.3	0.8	23.0
04/03/89	194	69078	3230	51.7	21.6	30.1	1.2	30.6
04/17/89	194	69092	3240	41.4	13.8	27.8	0.8	24.6
05/03/89	194	69108	3250	50.4	18.1	32.4	1.0	28.2
05/31/89	194	69136	3270	58.4	21.6	36.9	1.5	31.2
07/24/89	194	69190	3300	61.5	19.3	42.1	1.9	28.3
08/21/89	194	69218	3320	64.0	20.3	43.6	1.7	28.5
09/17/89	194	69245	3340	60.0	23.3	36.6	1.2	31.2
08/13/90	194	69575	3560	87.0	25.1	62.0	2.0	30.1
09/13/90	194	69606	3580	83.0	20.8	62.2	1.8	27.9
09/17/90	194	69610	3580	0.0	19.8	0.0	3.8	27.9
10/17/90	194	69640	3600	78.8	16.6	62.2	1.2	27.9
11/07/90	194	69661	3610	79.0	17.1	62.2	2.4	24.9
01/19/91	194	69734	3660	78.3	16.1	62.0	1.4	27.4
02/15/91	194	69761	3680	80.8	18.8	62.0	2.0	27.1
03/23/91	194	69797	3700	82.0	20.1	62.0	2.0	27.2
04/27/91	194	69832	3720	76.0	14.0	62.0	1.3	25.5
05/25/91	194	69860	3740	81.5	19.3	62.0	1.7	28.2
06/29/91	194	69895	3760	88.5	26.6	62.0	2.0	31.3
07/27/91	194	69923	3780	86.0	22.3	63.7	1.4	30.9
08/22/91	194	69949	3800	84.0	20.3	63.7	1.2	28.6
09/19/91	194	69977	3820	78.0	15.8	62.0	0.9	24.0
10/15/91	194	70003	3840	83.3	21.1	62.0	1.5	30.8
10/28/91	194	70016	3851	73.0	13.0	60.0	0.9	24.3
11/11/91	194	70030	3852	72.5	12.5	60.0	1.2	24.9
11/18/91	194	70037	3860	71.0	11.0	60.0	1.1	25.0
12/15/91	194	70064	3880	67.2	7.3	60.0	-0.6	17.4
01/17/92	194	70097	3900	71.7	13.3	58.4	1.5	24.7
02/27/92	194	70138	3920	68.5	10.0	58.4	1.2	23.1
03/27/92	194	70167	3940	67.0	8.5	58.4	0.9	22.4
04/15/92	194	70186	3960	63.2	4.8	58.4	0.2	17.4
05/14/92	194	70215	3970	73.7	15.1	58.7	1.3	24.7
06/10/92	194	70242	3990	66.0	7.3	58.7	1.1	21.2
06/30/92	194	70262	4010	77.3	18.6	58.7	2.6	27.2
07/28/92	194	70290	4020	75.3	16.6	58.7	1.6	26.7
08/25/92	194	70318	4042	72.5	13.8	58.7	1.6	25.5
09/07/92	194	70331	4050	65.7	7.0	58.7	0.8	20.5
09/23/92	194	70347	4060	64.7	7.5	57.2	1.0	22.6
10/19/92	194	70373	4080	66.2	9.0	57.2	0.5	19.8
11/08/92	194	70393	4090	62.7	5.8	57.2	0.6	19.1
12/13/92	194	70428	4120	67.0	9.5	57.4	0.8	21.6
01/21/93	194	70467	4140	80.3	22.8	57.4	-0.1	34.2
02/17/93	194	70494	4160	66.2	8.8	57.4	-0.1	17.4
03/20/93	194	70525	4180	66.5	8.5	57.9	0.7	21.2
04/22/93	194	70558	4200	71.5	13.8	57.9	1.4	25.5
05/20/93	194	70586	4220	69.7	12.0	57.9	1.3	23.7
06/16/93	194	70613	4240	68.5	10.5	57.9	1.6	23.1
07/14/93	194	70641	4260	66.0	8.8	57.4	1.3	22.6
08/17/93	194	70675	4280	67.2	9.8	57.4	1.1	23.0
08/30/93	194	70688	4290	66.2	8.8	57.4	1.0	22.6
09/13/93	194	70702	4300	71.7	14.3	57.4	1.4	25.0
10/11/93	194	70730	4320	62.7	5.3	57.4	0.9	20.3
11/07/93	194	70757	4330	60.2	3.0	57.2	0.4	17.4
12/17/93	194	70797	4360	66.7	9.3	57.4	0.9	22.1
01/28/94	194	70839	4380	62.7	5.0	57.4	-0.6	17.4
02/23/94	194	70865	4400	68.0	9.5	58.2	0.8	21.8
03/26/94	194	70896	4420	64.7	6.5	58.2	0.2	17.4

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
04/22/94	194	70923	4440	68.0	9.8	58.2	0.3	17.4
05/26/94	194	70957	4460	68.0	9.8	58.2	0.6	20.8
06/18/94	194	70980	4480	68.2	10.5	57.7	0.9	22.2
07/06/94	194	70998	4490	68.5	10.5	57.7	1.2	22.4
08/21/94	194	71044	4520	66.0	8.3	57.7	0.4	17.6
09/05/94	194	71059	4530	67.2	9.3	57.7	1.1	23.0
10/03/94	194	71087	4550	65.0	6.5	58.4	0.4	17.6
10/30/94	194	71114	4570	59.7	1.3	58.4	-1.0	17.4
11/15/94	194	71130	4580	55.7	0.0	55.7	-1.6	17.4
01/12/95	194	71188	4610	65.0	6.5	58.4	0.2	17.4
02/11/95	194	71218	4630	63.0	5.5	57.4	0.4	17.4
03/20/95	194	71255	4660	77.3	19.6	57.4	-0.0	35.8
04/13/95	194	71279	4670	58.4	0.8	57.7	-0.9	17.4
05/11/95	194	71307	4690	59.2	1.3	57.9	-0.5	17.4
06/07/95	194	71334	4710	56.2	0.0	56.2	-1.1	17.4
07/23/95	194	71380	4740	62.5	6.3	56.2	0.7	20.1
08/18/95	194	71406	4760	51.9	0.0	51.9	-1.6	17.4
09/18/95	194	71437	4780	51.9	0.0	51.9	-1.1	17.4

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
04/09/81	205	66162	1310	123.4	55.4	68.2	3.2	44.2
07/15/81	205	66259	1370	109.4	43.4	66.0	3.0	37.5
10/20/81	205	66356	1440	112.4	50.2	62.2	2.8	42.4
01/08/82	205	66436	1490	113.1	50.4	62.7	2.8	43.4
04/08/82	205	66526	1550	102.3	43.4	58.9	2.6	39.3
07/16/82	205	66625	1610	119.7	56.7	62.7	2.7	43.0
01/09/83	205	66802	1730	106.9	48.9	57.9	2.1	43.1
04/06/83	205	66889	1790	94.6	41.6	52.9	2.0	39.8
07/12/83	205	66986	1850	93.3	35.1	58.2	2.3	35.3
10/27/83	205	67093	1920	81.5	31.4	50.4	1.7	35.7
01/08/84	205	67166	1970	90.6	30.6	60.2	1.7	33.7
07/10/84	205	67350	2090	64.0	9.8	54.2	1.1	22.4
10/08/84	205	67440	2150	85.5	33.1	52.4	1.6	37.1
01/15/85	205	67539	2210	76.5	26.3	50.2	1.2	35.3
04/04/85	205	67618	2270	85.5	34.6	50.9	1.6	37.9
06/01/85	205	67676	2300	84.5	35.1	49.7	1.8	38.6
07/01/85	205	67706	2330	86.8	34.9	51.9	2.0	37.8
07/31/85	205	67736	2340	88.3	36.1	51.9	1.9	36.4
09/28/85	205	67795	2380	89.8	34.9	54.7	1.9	35.6
11/12/85	205	67840	2410	92.8	28.3	64.2	2.0	32.7
12/13/85	205	67871	2430	82.8	28.3	54.4	1.1	37.1
12/28/85	205	67886	2440	88.3	34.4	53.9	1.7	37.6
02/18/86	205	67938	2480	75.8	24.3	51.7	1.2	31.2
03/07/86	205	67955	2490	80.8	27.6	53.4	1.5	32.3
04/25/86	205	68004	2520	73.7	23.3	50.4	1.3	28.9
06/03/86	205	68043	2550	77.0	25.1	51.7	1.5	31.6
06/30/86	205	68070	2560	85.3	32.9	52.7	1.8	35.3
07/09/86	205	68079	2570	81.3	30.9	50.7	1.8	33.0
08/31/86	205	68132	2610	74.5	21.6	52.7	1.7	26.6
09/27/86	205	68159	2620	89.0	32.9	56.2	2.0	34.6
09/29/86	205	68161	2630	89.0	32.9	55.9	2.0	34.0
12/07/86	205	68230	2670	63.2	19.8	43.4	1.0	28.9
01/07/87	205	68261	2690	59.4	22.8	36.6	0.8	25.0
02/10/87	205	68295	2710	54.2	18.3	35.9	0.9	23.8
03/05/87	205	68318	2730	73.5	28.8	44.6	1.4	35.6
04/30/87	205	68374	2760	66.5	24.6	42.1	1.7	30.8
05/12/87	205	68386	2770	76.3	35.9	40.4	1.6	37.9
05/29/87	205	68403	2780	76.3	31.9	44.4	2.0	34.3
06/26/87	205	68431	2800	69.7	26.6	43.1	1.8	31.8
07/14/87	205	68449	2810	103.6	27.6	76.0	2.3	30.8
08/10/87	205	68476	2830	77.3	12.0	65.2	1.3	27.4
08/26/87	205	68492	2840	87.3	22.6	64.7	1.8	30.1
09/26/87	205	68523	2860	88.0	24.1	64.2	2.0	30.0
02/02/88	205	68652	2950	68.2	23.3	45.2	1.2	31.2
03/31/88	205	68710	2980	69.7	23.1	46.9	1.2	32.5
04/28/88	205	68738	3000	68.5	29.6	38.9	1.7	34.1
07/17/88	205	68818	3060	69.5	27.1	42.4	1.6	31.9
08/27/88	205	68859	3080	56.7	14.3	42.4	1.1	22.6
09/16/88	205	68879	3100	49.9	8.5	41.4	1.2	22.5
01/12/89	205	68997	3170	54.4	17.3	37.1	0.9	25.7
07/10/89	205	69176	3290	85.8	27.1	58.4	2.3	31.5
03/23/90	205	69432	3460	81.3	24.8	56.4	2.0	31.5
01/29/91	205	69744	3660	70.2	11.8	58.4	1.0	23.8
04/30/91	205	69835	3720	71.2	11.0	60.2	1.2	23.9
10/05/91	205	69993	3830	78.3	17.1	61.2	0.9	22.1
07/17/93	205	70644	4260	71.2	8.8	62.5	0.9	21.8

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
10/21/88	207	68914	3120	57.2	11.5	45.7	1.2	24.4
11/06/88	207	68930	3130	55.9	10.8	45.2	1.1	23.7
11/17/88	207	68941	3140	53.4	11.5	41.9	0.8	22.4
12/03/88	207	68957	3150	52.2	14.0	38.4	0.9	25.5
12/17/88	207	68971	3160	57.9	20.6	37.4	0.9	30.1
01/05/89	207	68990	3170	54.4	18.6	35.9	0.7	22.3
01/19/89	207	69004	3180	55.9	18.3	37.6	0.9	27.2
04/03/89	207	69078	3230	72.5	23.3	49.2	1.4	31.9
05/31/89	207	69136	3270	70.0	20.8	49.2	3.7	29.2
07/24/89	207	69190	3300	77.8	20.3	57.4	3.7	28.3
08/21/89	207	69218	3320	73.7	15.8	57.9	3.7	26.1
08/13/90	207	69575	3560	83.0	22.6	60.5	1.9	28.3
09/15/90	207	69608	3580	81.3	20.8	60.5	1.8	29.1
10/17/90	207	69640	3600	81.5	21.1	60.5	1.4	30.4
11/07/90	207	69661	3610	69.5	8.8	60.7	1.0	22.9
01/19/91	207	69734	3660	72.7	12.3	60.5	1.3	24.5
02/15/91	207	69761	3680	76.3	16.1	60.5	1.9	24.8
03/23/91	207	69797	3700	77.0	16.6	60.5	1.9	24.8
04/27/91	207	69832	3720	70.0	9.5	60.5	1.2	23.4
05/25/91	207	69860	3740	70.7	10.3	60.5	1.1	23.8
06/29/91	207	69895	3760	72.2	11.8	60.5	1.3	24.2
07/27/91	207	69923	3780	71.2	10.3	61.0	0.8	22.5
08/22/91	207	69949	3800	72.5	11.8	60.7	1.3	23.8
09/19/91	207	69977	3820	77.0	16.3	61.0	1.1	27.0
10/15/91	207	70003	3840	77.3	16.6	61.0	0.9	27.7
10/28/91	207	70016	3851	65.7	9.5	56.4	0.9	22.4
11/18/91	207	70037	3860	68.0	11.8	56.4	1.2	24.3
12/15/91	207	70064	3880	62.0	5.5	56.4	-0.3	17.4
01/17/92	207	70097	3900	72.0	13.8	58.2	1.3	25.4
02/27/92	207	70138	3920	68.7	10.3	58.2	1.1	23.4
03/27/92	207	70167	3940	65.5	7.3	58.2	0.8	21.4
04/15/92	207	70186	3960	73.0	14.5	58.2	1.0	25.2
06/10/92	207	70242	3990	72.2	12.8	59.7	1.4	23.0
07/28/92	207	70290	4020	70.7	11.0	59.7	1.3	23.8
08/25/92	207	70318	4042	64.2	4.8	59.7	0.5	18.5
09/07/92	207	70331	4050	66.5	7.5	58.9	0.7	20.3
09/23/92	207	70347	4060	63.7	6.5	57.2	0.8	21.0
10/19/92	207	70373	4080	64.7	7.5	57.2	0.3	17.4
11/08/92	207	70393	4090	63.7	6.5	57.2	0.4	17.6
12/13/92	207	70428	4120	61.5	7.0	54.2	0.8	20.9
01/21/93	207	70467	4140	61.5	7.3	54.2	0.0	17.4
02/17/93	207	70494	4160	54.2	0.0	54.2	-1.3	17.4
03/20/93	207	70525	4180	60.0	2.3	57.4	0.2	17.4
04/22/93	207	70558	4200	68.0	10.3	57.4	1.3	23.1
05/20/93	207	70586	4220	66.5	9.0	57.4	1.0	22.3
06/16/93	207	70613	4240	66.5	8.8	57.4	1.2	22.4
07/14/93	207	70641	4260	60.5	4.8	55.7	1.0	19.7
08/17/93	207	70675	4280	64.5	8.8	55.7	1.1	22.7
08/30/93	207	70688	4290	63.0	6.8	56.2	1.2	20.3
09/13/93	207	70702	4300	69.7	13.8	56.2	1.1	26.5
10/11/93	207	70730	4320	59.2	3.0	56.2	0.6	18.7
11/07/93	207	70757	4330	55.4	0.0	55.4	-0.4	17.4
12/17/93	207	70797	4360	65.5	9.5	56.2	0.9	22.1
01/28/94	207	70839	4380	63.5	7.5	56.2	-0.2	17.4
02/23/94	207	70865	4400	63.7	6.3	57.4	0.8	20.2
03/26/94	207	70896	4420	65.5	8.0	57.4	0.1	17.4
04/22/94	207	70923	4440	62.2	4.8	57.4	0.0	17.4
05/26/94	207	70957	4460	63.7	6.3	57.4	0.4	17.4
06/18/94	207	70980	4480	66.7	9.3	57.4	0.8	21.7
07/06/94	207	70998	4490	64.2	6.8	57.4	1.2	21.2
08/21/94	207	71044	4520	63.0	5.8	57.4	-0.2	17.4
09/05/94	207	71059	4530	64.0	6.8	57.4	0.9	21.1
10/03/94	207	71087	4550	60.2	1.5	58.7	-1.1	17.4
10/30/94	207	71114	4570	58.4	0.0	58.4	-1.3	17.4
11/15/94	207	71130	4580	53.4	0.0	53.4	-2.2	17.4
01/12/95	207	71188	4610	66.5	8.0	58.4	0.4	17.4
02/11/95	207	71218	4630	58.7	3.0	55.7	0.2	17.4

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
03/20/95	207	71255	4660	57.4	0.8	56.7	-0.5	17.4
04/13/95	207	71279	4670	55.7	0.0	55.7	-1.0	17.4
05/11/95	207	71307	4690	57.4	1.8	55.7	-1.0	17.4
06/07/95	207	71334	4710	60.5	2.8	57.7	0.5	18.2
07/23/95	207	71380	4740	61.7	4.0	57.7	0.4	17.6
08/18/95	207	71406	4760	60.0	1.3	58.7	0.2	17.4
09/18/95	207	71437	4780	66.7	8.3	58.7	1.2	22.3

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
09/29/85	209	67796	2390	88.0	35.9	52.2	1.9	36.1
12/13/85	209	67871	2430	76.8	29.3	47.4	1.1	38.5
12/28/85	209	67886	2440	82.8	32.6	50.2	1.7	34.8
02/19/86	209	67939	2480	75.5	26.3	49.2	1.1	35.1
03/07/86	209	67955	2490	77.5	26.3	51.2	1.4	32.6
04/25/86	209	68004	2520	71.0	22.3	48.9	1.2	27.1
12/07/86	209	68230	2670	89.0	22.8	66.2	3.9	27.8
01/07/87	209	68261	2690	83.5	18.8	64.7	2.9	26.9
02/10/87	209	68295	2710	67.7	21.1	46.7	1.3	26.3
03/08/87	209	68321	2730	74.0	25.3	48.7	1.8	30.7
04/02/87	209	68346	2750	79.3	28.6	50.7	2.1	30.4
04/30/87	209	68374	2760	83.8	29.6	54.2	1.8	34.3
05/29/87	209	68403	2780	79.3	30.4	48.9	1.8	32.9
06/26/87	209	68431	2800	74.2	24.8	49.4	1.9	31.0
08/24/87	209	68490	2840	71.0	19.6	51.4	2.1	29.0
09/26/87	209	68523	2860	67.0	15.8	51.2	1.9	26.2
02/02/88	209	68652	2950	67.2	22.8	44.4	0.9	31.3
04/28/88	209	68738	3000	67.0	27.3	39.6	1.6	32.6
08/27/88	209	68859	3080	73.2	7.0	66.2	3.6	18.0
03/23/90	209	69432	3460	84.3	20.8	63.5	3.5	29.3
07/01/90	209	69532	3530	87.0	20.8	66.5	3.7	27.6
01/15/91	209	69730	3650	81.0	14.8	66.2	4.1	25.4
04/29/91	209	69834	3720	76.5	10.8	65.7	3.4	22.9
06/06/92	209	70238	3990	80.0	13.5	66.5	3.2	24.5

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
09/28/85	216	67795	2380	85.3	34.9	50.4	1.9	35.1
11/04/85	216	67832	2410	78.3	31.4	46.7	1.6	35.1
11/29/85	216	67857	2430	75.3	27.3	48.2	1.6	32.9
02/10/87	216	68295	2710	43.9	15.3	28.3	0.7	21.5
03/08/87	216	68321	2730	67.0	26.6	40.1	1.6	32.3
04/02/87	216	68346	2740	65.2	25.3	39.9	1.4	33.5
04/30/87	216	68374	2760	58.2	21.3	36.6	1.2	29.3
05/29/87	216	68403	2780	66.7	24.1	42.6	1.9	30.2
06/26/87	216	68431	2800	67.7	24.6	43.1	1.9	30.7
10/21/88	216	68914	3120	49.4	9.0	40.4	0.9	22.9
11/06/88	216	68930	3130	43.6	7.8	35.6	0.8	21.5
11/17/88	216	68941	3140	38.9	6.8	32.1	0.5	19.4
12/03/88	216	68957	3150	35.6	7.8	27.8	0.6	20.4
12/17/88	216	68971	3160	39.4	14.0	25.3	0.7	22.3
01/05/89	216	68990	3170	30.9	13.0	17.8	0.0	10.7
01/19/89	216	69004	3180	42.4	15.6	26.8	0.8	25.9
02/01/89	216	69017	3190	48.4	17.6	30.9	1.1	26.9
02/16/89	216	69032	3200	38.6	13.0	25.6	0.5	20.3
03/11/89	216	69055	3210	15.1	6.8	8.5	-0.2	0.9
03/22/89	216	69066	3220	40.1	17.1	23.3	0.8	26.3
04/03/89	216	69078	3230	41.6	18.6	23.1	0.9	29.3
04/17/89	216	69092	3240	49.7	18.3	31.6	1.3	27.7
05/03/89	216	69108	3250	57.2	22.1	35.1	1.5	30.4
05/31/89	216	69136	3270	58.9	22.6	36.4	1.7	31.2
07/24/89	216	69190	3300	62.0	19.6	42.4	2.0	27.0
08/21/89	216	69218	3320	64.7	20.6	44.1	2.0	28.2
09/17/89	216	69245	3340	38.4	12.3	26.1	0.1	21.2
01/03/90	216	69353	3410	42.9	14.0	28.8	0.9	28.0
08/15/90	216	69577	3560	60.2	18.3	41.6	1.6	27.5
10/17/90	216	69640	3600	49.4	11.0	38.4	0.8	23.7
11/07/90	216	69661	3610	44.9	8.0	36.9	0.9	21.8
01/15/91	216	69730	3650	32.9	7.3	25.6	0.6	20.1
01/19/91	216	69734	3660	44.4	13.0	31.4	1.2	25.4
02/15/91	216	69761	3680	40.9	7.8	32.9	0.9	22.3
03/24/91	216	69798	3700	62.0	24.6	37.1	1.4	33.5
04/27/91	216	69832	3720	37.9	7.3	30.6	0.7	20.9
04/29/91	216	69834	3720	37.4	5.3	32.1	0.6	19.4
05/25/91	216	69860	3740	38.9	8.5	30.4	0.9	22.4
06/29/91	216	69895	3760	39.9	6.3	33.6	0.7	20.6
07/27/91	216	69923	3780	39.9	7.0	32.9	0.3	16.0
08/22/91	216	69949	3800	43.1	8.8	34.6	1.0	22.1
09/19/91	216	69977	3820	29.1	6.8	22.1	0.2	13.0
10/04/91	216	69992	3830	25.6	5.5	19.8	0.1	12.3
10/15/91	216	70003	3840	30.4	7.0	23.3	0.5	18.8
10/28/91	216	70016	3851	25.6	6.0	19.6	0.4	16.9
11/18/91	216	70037	3860	35.4	6.8	28.6	0.8	20.8
12/15/91	216	70064	3880	14.5	0.0	14.3	-0.3	8.5
01/17/92	216	70097	3900	34.6	6.0	28.6	0.7	20.0
02/27/92	216	70138	3920	35.1	7.0	28.1	0.8	21.2
03/27/92	216	70167	3940	49.4	12.5	36.9	1.3	25.1
04/15/92	216	70186	3960	34.9	5.8	29.3	0.5	18.4
05/14/92	216	70215	3970	35.1	5.0	30.1	0.7	19.9
06/10/92	216	70242	3990	36.4	5.3	31.1	0.4	17.2
07/28/92	216	70290	4020	42.1	7.5	34.9	0.8	21.0
08/25/92	216	70318	4042	44.1	7.8	36.4	0.8	21.1
09/07/92	216	70331	4050	42.4	9.5	33.1	0.7	20.7
09/23/92	216	70347	4060	17.8	1.8	16.1	-0.1	9.5
10/19/92	216	70373	4080	20.6	4.8	15.8	0.2	9.5
11/08/92	216	70393	4090	25.6	1.8	23.8	0.1	13.4
12/13/92	216	70428	4120	27.8	4.3	23.6	0.4	17.0
01/21/93	216	70467	4140	29.1	6.5	22.3	0.3	15.8
02/17/93	216	70494	4160	19.6	2.3	17.3	-0.2	10.5
03/20/93	216	70525	4180	21.8	4.0	17.8	0.2	13.8
04/22/93	216	70558	4200	39.1	6.3	32.6	0.9	20.8
05/20/93	216	70586	4220	39.1	5.5	33.6	0.5	18.0
06/16/93	216	70613	4240	44.4	9.5	34.9	0.9	22.5
07/14/93	216	70641	4260	45.2	6.5	38.9	0.9	20.8

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08/17/93	216	70675	4280	38.6	6.5	32.1	0.7	20.9
08/30/93	216	70688	4290	38.6	4.3	34.4	0.7	19.4
09/13/93	216	70702	4300	34.1	5.3	28.8	0.4	17.3
10/11/93	216	70730	4320	22.1	0.5	21.6	0.0	13.6
11/07/93	216	70757	4330	24.3	2.5	21.8	0.2	15.1
12/17/93	216	70797	4360	30.9	5.5	25.3	0.5	18.3
01/28/94	216	70839	4380	19.3	5.8	13.5	-0.4	8.8
02/23/94	216	70865	4400	26.1	7.0	19.1	0.4	17.0
03/26/94	216	70896	4420	23.8	3.8	20.1	0.1	12.6
04/22/94	216	70923	4440	22.8	4.0	18.8	-0.0	11.7
05/26/94	216	70957	4460	21.6	5.3	16.1	0.3	12.6
06/18/94	216	70980	4480	31.6	4.5	26.8	0.3	15.7
07/06/94	216	70998	4490	38.6	7.0	31.6	0.8	21.0
08/21/94	216	71044	4520	24.6	7.5	17.1	0.2	11.7
09/05/94	216	71059	4530	19.1	4.3	14.8	0.3	13.6
10/03/94	216	71087	4550	16.8	4.0	12.8	0.0	6.6
10/30/94	216	71114	4570	16.8	2.5	14.3	-0.2	8.9
11/15/94	216	71130	4580	8.8	0.0	8.8	-0.3	1.9
01/12/95	216	71188	4610	18.3	4.5	13.8	0.1	7.8
02/11/95	216	71218	4630	13.8	1.0	12.8	-0.1	6.3
03/20/95	216	71255	4660	4.0	0.0	3.8	-0.4	-2.9
04/13/95	216	71279	4670	11.3	0.5	10.8	-0.2	5.4
05/11/95	216	71307	4690	18.1	3.3	14.8	0.0	8.0
06/07/95	216	71334	4710	39.1	7.5	31.9	0.8	21.7
07/23/95	216	71380	4740	42.9	7.5	35.1	0.6	18.8
08/18/95	216	71406	4760	16.3	1.3	15.1	-0.1	8.7
09/18/95	216	71437	4780	10.5	0.0	10.5	-0.8	5.0

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
09/29/85	220	67796	2390	118.6	45.9	72.7	2.3	39.6
11/04/85	220	67832	2400	100.3	36.4	64.0	1.8	37.1
11/29/85	220	67857	2430	103.3	38.6	65.0	2.0	37.3
12/27/85	220	67885	2440	102.3	39.4	63.0	1.7	37.7
02/19/86	220	67939	2480	98.1	34.4	63.7	1.4	38.1
03/07/86	220	67955	2490	97.8	34.4	63.5	1.8	36.7
06/04/86	220	68044	2550	103.8	41.1	62.7	2.1	40.8
06/30/86	220	68070	2560	101.8	39.1	62.7	2.1	38.0
08/11/86	220	68112	2590	103.3	41.6	61.7	2.1	38.5
08/31/86	220	68132	2610	92.1	32.9	59.2	2.0	32.9
09/27/86	220	68159	2620	101.1	40.1	60.7	2.1	38.6
12/07/86	220	68230	2670	84.0	33.4	50.7	1.3	37.1
01/06/87	220	68260	2690	72.0	25.8	46.2	1.2	32.9
02/10/87	220	68295	2710	71.5	24.6	46.9	1.2	30.5
03/08/87	220	68321	2730	83.3	33.9	49.4	1.7	36.7
04/02/87	220	68346	2740	84.8	36.1	48.7	1.8	37.8
04/30/87	220	68374	2760	77.8	31.1	46.7	1.7	35.7
05/29/87	220	68403	2780	82.3	34.1	48.2	1.9	35.7
06/26/87	220	68431	2800	74.8	25.8	48.9	1.8	32.0
08/24/87	220	68490	2840	78.5	28.3	50.2	1.9	33.5
09/23/87	220	68520	2860	81.3	31.1	50.4	2.0	32.7
04/29/88	220	68739	3000	73.2	35.9	37.4	1.5	37.4
08/24/88	220	68856	3080	48.2	10.8	37.4	1.0	21.3
10/21/88	220	68914	3120	47.9	10.3	37.6	1.0	23.6
11/06/88	220	68930	3130	51.2	13.8	37.6	1.1	25.7
11/17/88	220	68941	3140	47.9	12.3	35.9	0.9	24.2
12/03/88	220	68957	3150	42.1	10.3	31.9	0.8	23.0
12/17/88	220	68971	3160	42.6	13.3	29.6	0.7	24.1
01/05/89	220	68990	3170	40.4	13.5	26.6	0.4	17.2
01/19/89	220	69004	3180	50.9	19.3	31.4	0.9	29.4
02/01/89	220	69017	3190	50.7	17.6	33.1	1.0	27.0
02/16/89	220	69032	3200	47.4	15.6	31.9	0.7	23.6
03/11/89	220	69055	3210	33.4	13.8	19.6	0.4	16.4
03/22/89	220	69066	3220	41.1	15.1	26.1	0.8	23.0
04/03/89	220	69078	3230	48.9	22.3	26.6	1.1	31.7
04/17/89	220	69092	3240	48.9	16.8	31.9	1.1	27.7
05/03/89	220	69108	3250	57.9	22.6	35.6	1.6	30.8
05/31/89	220	69136	3270	62.0	23.1	38.9	1.7	31.3
07/24/89	220	69190	3300	65.2	23.6	41.6	2.2	29.7
08/21/89	220	69218	3320	68.2	24.8	43.4	2.1	30.4
09/17/89	220	69245	3340	48.4	14.0	34.4	0.8	24.8
01/03/90	220	69353	3410	45.9	17.8	28.1	0.9	31.0
03/23/90	220	69432	3460	47.9	14.8	33.1	1.2	26.8
07/01/90	220	69532	3530	44.9	8.0	36.9	1.1	21.9
08/15/90	220	69577	3560	54.9	14.8	40.4	1.2	25.6
09/15/90	220	69608	3580	46.4	6.5	40.1	0.9	21.0
10/17/90	220	69640	3600	51.2	13.5	37.6	1.1	25.8
11/07/90	220	69661	3610	36.6	5.3	31.4	0.5	19.0
01/15/91	220	69730	3650	31.1	6.0	25.1	0.5	18.7
01/19/91	220	69734	3660	35.4	11.0	24.3	0.6	23.6
02/15/91	220	69761	3680	42.4	12.3	30.1	0.8	23.9
03/24/91	220	69798	3700	27.1	3.0	24.1	0.3	15.8
04/27/91	220	69832	3720	27.6	0.8	27.1	0.5	18.2
04/29/91	220	69834	3720	34.1	5.0	29.1	0.5	18.6
05/25/91	220	69860	3740	34.6	6.0	28.6	0.6	19.3
06/29/91	220	69895	3760	35.6	6.0	29.6	0.7	19.6
07/27/91	220	69923	3780	36.9	6.0	30.6	0.4	17.1
08/22/91	220	69949	3800	36.1	6.8	29.3	0.6	19.1
09/19/91	220	69977	3820	32.6	6.3	26.3	0.4	17.1
10/04/91	220	69992	3830	32.6	10.5	21.8	0.3	14.3
10/15/91	220	70003	3840	36.9	9.0	27.8	0.7	21.7
10/28/91	220	70016	3851	20.1	3.5	16.6	0.2	12.5
11/18/91	220	70037	3860	28.8	3.8	24.8	0.4	16.7
12/15/91	220	70064	3880	20.8	4.8	16.3	0.2	11.0
01/17/92	220	70097	3900	29.8	4.5	25.3	0.5	17.8
02/27/92	220	70138	3920	23.1	2.5	20.6	0.2	15.3
03/27/92	220	70167	3940	19.6	1.5	18.1	0.1	12.0

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
04/15/92	220	70186	3960	18.6	1.8	16.8	0.1	11.7
05/14/92	220	70215	3970	22.8	1.8	21.1	0.0	13.6
06/10/92	220	70242	3990	25.6	3.8	21.8	0.2	12.1
07/28/92	220	70290	4020	30.4	3.3	26.8	0.2	15.6
08/25/92	220	70318	4042	24.8	2.3	22.6	0.1	12.6
09/07/92	220	70331	4050	26.8	4.5	22.3	0.2	14.4
09/23/92	220	70347	4060	15.3	0.8	14.5	-0.1	8.1
10/19/92	220	70373	4080	20.3	4.3	16.3	0.2	10.7
11/08/92	220	70393	4090	13.8	-2.0	16.1	0.0	11.6
12/13/92	220	70428	4120	22.8	4.3	18.6	0.2	13.8
01/21/93	220	70467	4140	29.1	8.0	21.1	0.3	14.2
02/17/93	220	70494	4160	23.1	6.3	17.1	0.2	12.3
03/20/93	220	70525	4180	23.6	4.0	19.3	0.4	16.4
04/22/93	220	70558	4200	38.4	7.8	30.6	0.8	21.7
05/20/93	220	70586	4220	35.1	7.3	27.8	0.6	20.6
06/16/93	220	70613	4240	39.1	8.5	30.6	0.7	22.0
07/14/93	220	70641	4260	42.1	7.5	34.6	0.9	20.3
08/17/93	220	70675	4280	37.1	8.3	28.8	0.5	18.7
08/30/93	220	70688	4290	33.9	6.0	28.1	0.5	18.3
09/13/93	220	70702	4300	37.1	8.5	28.3	0.6	19.8
10/11/93	220	70730	4320	18.3	0.5	17.8	-0.1	10.1
11/07/93	220	70757	4330	17.1	1.3	15.8	-0.0	9.0
12/17/93	220	70797	4360	25.3	5.5	19.8	0.3	14.8
01/28/94	220	70839	4380	22.3	6.5	15.8	0.2	11.4
02/23/94	220	70865	4400	26.3	7.0	19.3	0.4	17.2
03/26/94	220	70896	4420	26.8	6.8	20.1	0.3	15.2
04/22/94	220	70923	4440	27.8	7.8	20.3	0.4	16.3
05/26/94	220	70957	4460	33.1	14.3	18.8	0.3	14.1
06/18/94	220	70980	4480	29.8	6.0	24.1	0.4	17.8
07/06/94	220	70998	4490	38.6	8.8	30.1	0.9	21.5
08/21/94	220	71044	4520	25.8	6.5	19.3	0.3	14.8
09/05/94	220	71059	4530	34.4	9.8	24.6	0.5	20.0
10/03/94	220	71087	4550	24.6	6.8	17.8	0.2	12.1
10/30/94	220	71114	4570	11.5	4.0	7.5	-0.3	3.1
11/15/94	220	71130	4580	11.8	4.5	7.3	-0.1	-0.4
01/12/95	220	71188	4610	17.8	5.5	12.5	0.1	5.2
02/11/95	220	71218	4630	15.1	2.0	13.0	0.0	7.2
03/20/95	220	71255	4660	19.8	5.0	14.8	0.2	8.7
04/13/95	220	71279	4670	16.1	3.3	12.8	0.0	6.5
05/11/95	220	71307	4690	15.3	3.0	12.5	-0.1	7.0
06/07/95	220	71334	4710	13.3	0.3	13.0	-0.2	7.4
07/23/95	220	71380	4740	19.6	0.0	19.6	-0.2	10.9
08/18/95	220	71406	4760	18.6	1.3	17.3	-0.0	10.5
09/18/95	220	71437	4780	11.3	0.0	11.3	-0.8	7.0

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
10/21/88	226	68914	3120	84.8	25.8	58.9	2.2	31.3
11/06/88	226	68930	3130	86.0	23.3	62.7	2.0	30.5
11/17/88	226	68941	3140	81.8	15.8	66.0	1.2	24.4
12/03/88	226	68957	3150	90.6	26.3	64.5	4.4	34.3
12/17/88	226	68971	3160	92.1	26.6	65.5	4.3	31.2
01/05/89	226	68990	3170	87.3	21.8	65.5	4.3	23.5
01/19/89	226	69004	3180	93.1	26.6	66.7	4.3	34.0
02/01/89	226	69017	3190	95.3	25.8	69.7	4.4	31.1
04/03/89	226	69078	3230	106.9	38.4	68.2	4.4	41.6
04/17/89	226	69092	3240	100.1	32.6	67.5	4.4	33.4
05/03/89	226	69108	3250	110.6	40.1	70.5	4.4	39.2
05/31/89	226	69136	3270	115.9	46.7	69.2	4.4	41.7
07/24/89	226	69190	3300	114.4	44.9	69.7	4.4	39.3
08/21/89	226	69218	3320	118.9	47.7	71.2	4.4	38.6
08/13/90	226	69575	3560	91.3	21.3	70.0	1.9	28.9
09/15/90	226	69608	3580	86.8	16.8	70.0	4.4	26.4
10/17/90	226	69640	3600	103.8	32.9	71.0	4.4	36.5
11/07/90	226	69661	3610	83.3	12.5	70.7	1.6	24.8
01/19/91	226	69734	3660	96.8	25.8	71.0	4.4	33.3
02/15/91	226	69761	3680	92.8	21.8	71.0	4.4	29.4
03/23/91	226	69797	3700	89.5	19.6	70.0	1.9	28.5
04/27/91	226	69832	3720	89.0	16.6	72.2	4.4	26.4
05/25/91	226	69860	3740	86.0	16.6	69.5	1.6	26.9
06/29/91	226	69895	3760	96.1	26.8	69.5	1.8	30.7
07/27/91	226	69923	3780	81.5	9.0	72.5	0.7	21.1
08/22/91	226	69949	3800	87.3	14.5	72.5	1.5	25.8
09/19/91	226	69977	3820	69.2	2.0	67.2	0.2	17.4
10/15/91	226	70003	3840	78.3	11.0	67.2	0.9	22.5
10/28/91	226	70016	3851	81.0	10.3	70.7	0.8	22.6
11/18/91	226	70037	3860	82.5	11.8	70.7	1.2	24.4
12/15/91	226	70064	3880	77.3	6.5	70.7	-0.4	17.4
01/17/92	226	70097	3900	82.5	11.5	71.0	1.3	23.9
02/27/92	226	70138	3920	85.0	14.3	71.0	1.1	26.5
03/27/92	226	70167	3940	95.1	24.1	71.0	1.9	34.1
04/15/92	226	70186	3960	80.3	9.3	71.0	0.8	21.4
05/14/92	226	70215	3970	79.3	9.3	70.0	1.2	23.0
06/10/92	226	70242	3990	77.0	7.0	70.0	0.6	19.9
07/28/92	226	70290	4020	82.5	12.5	70.0	1.3	24.5
08/25/92	226	70318	4042	82.0	12.3	70.0	1.2	23.4
09/07/92	226	70331	4050	79.8	10.0	69.7	0.8	20.8
09/23/92	226	70347	4060	75.3	7.8	67.7	0.9	22.0
10/19/92	226	70373	4080	73.2	5.5	67.7	-0.1	17.4
11/08/92	226	70393	4090	74.5	6.8	67.7	0.1	17.4
12/13/92	226	70428	4120	77.3	9.3	67.7	0.8	21.7
01/21/93	226	70467	4140	78.5	10.5	67.7	0.5	18.9
02/17/93	226	70494	4160	70.2	2.3	67.7	-0.6	17.4
03/20/93	226	70525	4180	77.5	9.0	68.7	0.8	21.8
04/22/93	226	70558	4200	81.3	12.5	68.7	1.3	25.0
05/20/93	226	70586	4220	82.8	14.0	68.7	1.3	25.9
06/16/93	226	70613	4240	82.5	13.8	68.7	1.4	25.7
07/14/93	226	70641	4260	79.8	9.8	70.0	1.3	23.0
08/17/93	226	70675	4280	85.3	15.3	70.0	1.4	26.5
08/30/93	226	70688	4290	83.8	14.0	70.0	1.5	25.4
09/13/93	226	70702	4300	82.3	12.3	70.0	1.1	23.6
10/11/93	226	70730	4320	75.3	5.5	69.7	0.9	20.6
11/07/93	226	70757	4330	76.0	5.8	70.2	4.5	20.6
12/17/93	226	70797	4360	79.5	9.5	70.0	0.8	21.8
01/28/94	226	70839	4380	79.0	9.0	70.0	0.3	17.4
02/23/94	226	70865	4400	80.8	11.5	69.5	0.9	22.6
03/26/94	226	70896	4420	76.3	7.0	69.5	-0.2	17.4
04/22/94	226	70923	4440	79.8	10.3	69.5	-0.0	17.4
05/26/94	226	70957	4460	76.3	6.8	69.5	0.4	17.4
06/18/94	226	70980	4480	73.0	4.3	69.0	0.5	18.3
07/06/94	226	70998	4490	78.8	9.8	69.0	1.2	22.5
08/21/94	226	71044	4520	77.5	8.5	69.0	0.4	17.4
09/05/94	226	71059	4530	84.0	15.3	69.0	1.2	26.3
10/03/94	226	71087	4550	77.3	4.0	73.2	-0.3	17.4

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
10/30/94	226	71114	4570	76.0	2.8	73.2	0.2	17.4
11/15/94	226	71130	4580	47.7	3.3	44.4	0.8	19.8
01/12/95	226	71188	4610	35.6	8.5	27.1	0.6	21.2
02/11/95	226	71218	4630	32.1	4.3	27.6	0.6	20.2
03/20/95	226	71255	4660	36.4	8.0	28.1	0.4	16.9
04/13/95	226	71279	4670	29.8	2.5	27.3	0.3	15.5
05/11/95	226	71307	4690	31.6	3.5	27.8	0.4	16.3
06/07/95	226	71334	4710	39.4	6.5	32.9	0.6	20.2
07/23/95	226	71380	4740	58.7	11.3	47.4	1.2	24.2
08/18/95	226	71406	4760	22.1	1.0	20.8	0.0	13.3
09/18/95	226	71437	4780	37.4	3.3	34.1	0.4	17.2

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
10/21/88	230	68914	3120	71.2	22.6	48.7	1.8	29.4
11/06/88	230	68930	3130	67.5	19.8	47.7	1.3	29.0
11/17/88	230	68941	3140	73.5	24.6	48.9	1.4	30.7
12/03/88	230	68957	3150	79.5	33.4	46.2	1.5	37.2
12/17/88	230	68971	3160	73.5	27.1	46.4	1.3	30.5
01/05/89	230	68990	3170	72.7	25.3	47.4	1.3	28.5
01/19/89	230	69004	3180	78.5	30.1	48.4	1.3	36.1
02/01/89	230	69017	3190	79.0	30.6	48.4	1.4	34.7
02/16/89	230	69032	3200	74.5	28.6	45.9	1.3	32.8
03/11/89	230	69055	3210	56.7	29.6	27.1	0.8	30.5
03/22/89	230	69066	3220	86.3	29.3	56.7	1.1	34.7
04/03/89	230	69078	3230	102.6	44.6	57.9	1.4	44.0
04/17/89	230	69092	3240	107.6	47.2	60.7	2.6	40.4
05/03/89	230	69108	3250	103.6	45.2	58.2	1.9	41.9
05/31/89	230	69136	3270	110.1	52.4	57.9	2.1	44.3
07/24/89	230	69190	3300	113.9	56.4	57.4	2.0	42.6
08/21/89	230	69218	3320	116.6	58.9	57.7	2.3	43.5
09/17/89	230	69245	3340	92.6	35.6	56.7	1.9	36.9
08/15/90	230	69577	3560	79.3	25.1	54.2	1.9	30.1
09/15/90	230	69608	3580	76.5	20.3	55.9	2.0	29.0
10/17/90	230	69640	3600	88.3	31.6	56.9	2.1	35.3
01/19/91	230	69734	3660	62.5	24.1	38.4	1.3	32.8
02/15/91	230	69761	3680	67.2	27.1	40.1	1.4	33.6
04/27/91	230	69832	3720	60.5	19.1	41.4	1.9	27.5
05/25/91	230	69860	3740	78.3	22.6	55.4	1.6	31.4
06/29/91	230	69895	3760	75.3	24.1	51.4	1.5	31.2
07/27/91	230	69923	3780	77.0	24.6	52.7	2.0	30.2
08/22/91	230	69949	3800	83.5	28.3	54.9	1.6	33.4
09/19/91	230	69977	3820	64.7	18.6	46.2	0.9	26.0
10/15/91	230	70003	3840	66.0	19.6	46.7	0.9	31.0
10/29/91	230	70017	3851	47.2	16.1	31.1	0.9	27.7
11/18/91	230	70037	3860	49.9	18.1	31.9	1.3	28.5
12/15/91	230	70064	3880	39.9	11.5	28.3	0.6	20.6
01/17/92	230	70097	3900	43.1	10.8	32.4	0.7	21.4
02/27/92	230	70138	3920	51.7	16.8	34.9	1.2	28.0
03/27/92	230	70167	3940	46.7	11.0	35.9	1.0	25.1
04/15/92	230	70186	3960	46.2	13.0	33.4	0.9	25.1
05/14/92	230	70215	3970	49.7	14.0	35.6	1.2	25.5
06/10/92	230	70242	3990	48.4	12.8	35.9	0.9	22.2
07/28/92	230	70290	4020	63.0	22.6	40.4	1.9	29.4
08/25/92	230	70318	4042	65.5	25.1	40.6	2.0	30.7
09/07/92	230	70331	4050	63.0	20.3	42.6	1.7	26.8
09/23/92	230	70347	4060	40.6	8.3	32.4	0.7	20.4
10/19/92	230	70373	4080	35.4	11.0	24.3	0.4	16.3
11/08/92	230	70393	4090	46.7	14.0	32.6	0.9	26.2
12/13/92	230	70428	4120	39.1	11.0	28.3	0.7	21.9
01/21/93	230	70467	4140	45.9	16.8	29.1	0.8	24.7
02/17/93	230	70494	4160	39.6	11.3	28.3	0.6	20.8
03/20/93	230	70525	4180	40.1	12.0	27.8	0.7	23.4
04/22/93	230	70558	4200	56.9	18.8	38.1	1.5	28.8
05/20/93	230	70586	4220	56.2	18.3	37.9	1.3	27.9
06/16/93	230	70613	4240	61.7	21.1	40.9	1.5	30.3
07/14/93	230	70641	4260	68.7	27.3	41.1	1.9	30.9
08/17/93	230	70675	4280	63.5	21.6	41.9	1.4	29.0
08/30/93	230	70688	4290	76.3	30.6	45.7	2.0	32.6
09/13/93	230	70702	4300	67.7	25.8	41.9	1.7	30.8
10/11/93	230	70730	4320	51.2	11.8	39.4	1.0	24.4
11/07/93	230	70757	4330	50.9	12.0	38.9	1.2	24.8
12/17/93	230	70797	4360	46.2	13.3	32.9	0.9	23.9
01/28/94	230	70839	4380	33.6	12.0	21.6	0.4	17.6
02/23/94	230	70865	4400	42.1	16.3	25.8	0.8	26.6
03/26/94	230	70896	4420	39.1	12.0	27.1	0.6	22.1
04/22/94	230	70923	4440	44.6	15.1	29.6	0.8	23.9
05/26/94	230	70957	4460	26.6	9.5	17.3	0.2	11.5
06/18/94	230	70980	4480	50.7	18.1	32.6	1.5	27.7
07/06/94	230	70998	4490	67.0	27.6	39.4	1.4	34.5
08/21/94	230	71044	4520	47.4	13.5	34.1	0.8	22.4

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
09/05/94	230	71059	4530	37.6	10.3	27.3	0.5	20.4
10/03/94	230	71087	4550	34.4	10.0	24.3	0.3	14.3
10/30/94	230	71114	4570	42.6	10.5	32.1	1.0	23.4
11/15/94	230	71130	4580	20.1	6.0	14.0	0.1	8.9
01/12/95	230	71188	4610	36.9	12.5	24.1	0.5	20.1
02/11/95	230	71218	4630	27.3	5.8	21.6	0.4	16.6
03/20/95	230	71255	4660	26.8	5.8	21.1	0.2	13.4
04/13/95	230	71279	4670	36.1	7.3	28.8	0.5	18.3
05/11/95	230	71307	4690	43.1	9.5	33.6	0.7	20.7
06/07/95	230	71334	4710	54.9	10.0	44.9	1.3	23.2
07/23/95	230	71380	4740	65.7	13.5	52.2	1.0	22.6
08/18/95	230	71406	4760	22.3	0.0	22.3	0.0	12.2
09/18/95	230	71437	4780	37.4	3.5	33.9	0.4	17.7

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
10/21/88	234	68914	3120	100.3	42.4	57.9	2.2	38.0
11/06/88	234	68930	3130	102.6	45.2	57.7	2.2	40.7
11/17/88	234	68941	3140	94.6	36.9	57.7	2.2	35.1
12/03/88	234	68957	3150	97.1	37.4	59.7	2.0	40.0
12/17/88	234	68971	3160	92.8	30.4	62.7	1.7	31.2
01/05/89	234	68990	3170	88.5	26.3	62.2	1.6	29.0
01/19/89	234	69004	3180	96.3	35.1	61.0	1.7	33.3
02/01/89	234	69017	3190	101.1	27.8	73.2	1.6	33.6
04/03/89	234	69078	3230	118.9	49.7	69.0	1.9	46.3
04/17/89	234	69092	3240	115.9	47.9	68.0	2.0	42.6
05/03/89	234	69108	3250	115.6	46.9	68.7	4.4	42.7
05/31/89	234	69136	3270	116.9	49.7	67.2	4.4	43.7
07/24/89	234	69190	3300	117.1	51.4	65.7	4.4	41.3
08/21/89	234	69218	3320	117.1	50.4	66.7	4.3	40.4
08/13/90	234	69575	3560	97.3	25.1	72.5	4.4	29.9
09/15/90	234	69608	3580	102.1	29.6	72.5	2.2	33.1
10/17/90	234	69640	3600	106.1	33.6	72.5	4.4	35.6
11/07/90	234	69661	3610	98.3	27.1	71.2	1.7	33.3
01/19/91	234	69734	3660	106.9	34.4	72.5	4.4	37.7
02/15/91	234	69761	3680	102.6	30.4	72.5	4.4	32.9
03/23/91	234	69797	3700	102.1	29.6	72.5	4.4	33.4
04/27/91	234	69832	3720	103.1	30.6	72.5	4.4	32.7
05/25/91	234	69860	3740	104.1	31.6	72.5	4.4	34.9
06/29/91	234	69895	3760	105.9	33.4	72.5	4.4	34.8
07/27/91	234	69923	3780	103.3	31.1	72.2	2.3	32.8
08/22/91	234	69949	3800	100.6	28.1	72.2	2.0	32.8
09/19/91	234	69977	3820	93.1	19.8	73.2	1.4	27.0
10/15/91	234	70003	3840	93.8	20.6	73.2	1.1	30.8
10/28/91	234	70016	3851	96.1	21.8	74.2	4.4	30.4
11/18/91	234	70037	3860	102.1	27.6	74.2	4.4	33.0
12/15/91	234	70064	3880	91.1	16.6	74.2	4.4	24.1
01/17/92	234	70097	3900	98.3	25.6	72.7	1.6	31.7
02/27/92	234	70138	3920	94.8	22.1	72.7	1.4	31.0
03/27/92	234	70167	3940	93.1	20.6	72.7	1.6	29.3
04/15/92	234	70186	3960	93.8	21.1	72.7	1.7	28.7
05/14/92	234	70215	3970	87.8	18.1	69.7	1.7	26.5
06/10/92	234	70242	3990	88.0	18.3	69.7	1.6	26.6
07/28/92	234	70290	4020	96.8	27.1	69.7	2.0	31.6
09/07/92	234	70331	4050	100.1	30.1	70.0	2.3	31.0
09/23/92	234	70347	4060	83.8	14.3	69.5	1.4	24.3
10/19/92	234	70373	4080	84.0	14.5	69.5	0.8	21.7
11/08/92	234	70393	4090	87.5	18.1	69.5	1.3	26.2
12/11/92	234	70426	4120	87.0	15.6	71.5	1.3	25.4
01/21/93	234	70467	4140	89.5	18.1	71.5	1.2	27.2
02/17/93	234	70494	4160	90.1	18.6	71.5	0.9	25.2
03/20/93	234	70525	4180	82.3	19.3	63.0	1.3	28.2
04/22/93	234	70558	4200	88.0	25.1	63.0	2.0	31.5
05/20/93	234	70586	4220	87.8	24.8	63.0	2.0	30.9
06/16/93	234	70613	4240	100.8	37.9	63.0	2.2	35.9
07/14/93	234	70641	4260	91.1	27.3	63.7	2.0	31.0
08/17/93	234	70675	4280	88.0	24.3	63.7	1.8	31.7
08/30/93	234	70688	4290	85.3	21.6	63.7	2.0	28.9
09/13/93	234	70702	4300	84.5	21.1	63.7	1.7	29.3
10/11/93	234	70730	4320	78.8	15.1	63.7	1.4	26.9
11/07/93	234	70757	4330	82.8	19.3	63.2	1.6	28.5
12/17/93	234	70797	4360	82.0	18.3	63.7	1.2	26.0
01/28/94	234	70839	4380	80.5	17.1	63.7	0.9	22.1
02/23/94	234	70865	4400	85.5	20.8	64.5	1.2	29.4
03/26/94	234	70896	4420	82.3	17.8	64.5	0.9	26.9
04/22/94	234	70923	4440	83.0	18.3	64.5	1.1	26.1
05/26/94	234	70957	4460	82.0	17.3	64.5	0.9	25.7
06/18/94	234	70980	4480	86.8	24.6	62.2	2.0	30.8
07/06/94	234	70998	4490	92.8	30.4	62.2	2.0	34.1
08/21/94	234	71044	4520	76.5	14.3	62.2	1.1	24.4
09/05/94	234	71059	4530	79.8	17.3	62.2	1.7	26.6
10/03/94	234	71087	4550	82.5	19.6	63.2	1.1	28.4
10/30/94	234	71114	4570	81.8	18.6	63.2	1.2	24.2

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
11/15/94	234	71130	4580	60.0	0.0	60.0	-1.5	17.4
01/12/95	234	71188	4610	74.5	11.3	63.2	1.1	23.0
02/11/95	234	71218	4630	74.8	9.8	65.0	0.6	19.7
03/20/95	234	71255	4660	80.5	15.6	65.0	0.9	25.2
04/13/95	234	71279	4670	76.8	11.8	65.0	0.8	22.5
05/11/95	234	71307	4690	75.3	10.5	65.0	1.3	23.6
06/07/95	234	71334	4710	77.5	14.5	63.0	1.8	25.6
07/23/95	234	71380	4740	94.6	31.6	63.0	1.7	34.8
08/18/95	234	71406	4760	76.5	12.3	64.2	1.2	24.9
09/18/95	234	71437	4780	72.0	7.8	64.2	1.1	22.0

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
08/15/90	240	69577	3560	82.5	34.6	47.9	2.3	34.4
09/15/90	240	69608	3580	88.3	36.9	51.4	2.5	35.0
10/17/90	240	69640	3600	94.1	42.9	51.2	2.6	40.0
11/07/90	240	69661	3610	83.0	38.1	44.9	2.0	36.6
01/19/91	240	69734	3660	99.6	51.7	47.9	2.3	48.2
02/15/91	240	69761	3680	86.3	42.6	43.6	1.6	40.3
03/24/91	240	69798	3700	90.8	43.9	46.9	2.0	39.7
04/27/91	240	69832	3720	82.3	32.9	49.4	2.0	35.1
05/25/91	240	69860	3740	84.8	35.1	49.7	1.9	37.1
06/29/91	240	69895	3760	91.3	43.6	47.7	1.9	40.8
07/27/91	240	69923	3780	88.0	40.9	47.2	2.0	38.7
08/22/91	240	69949	3800	85.8	37.4	48.7	1.9	37.7
09/19/91	240	69977	3820	85.0	36.1	49.2	1.9	37.4
10/15/91	240	70003	3840	81.5	31.9	49.7	1.7	37.6
10/29/91	240	70017	3851	78.5	33.6	44.9	1.4	38.0
11/18/91	240	70037	3860	75.0	41.1	34.1	1.3	40.7
12/15/91	240	70064	3880	68.0	32.4	35.6	1.6	32.7
01/17/92	240	70097	3900	83.8	41.6	42.1	1.6	41.8
02/27/92	240	70138	3920	88.3	44.9	43.4	1.9	42.5
03/27/92	240	70167	3940	107.1	58.2	49.2	2.1	46.9
04/15/92	240	70186	3960	84.8	40.4	44.4	2.1	38.2
05/14/92	240	70215	3970	75.3	33.9	41.4	1.4	36.5
06/10/92	240	70242	3990	82.8	39.9	42.6	1.6	37.3
07/28/92	240	70290	4020	95.1	50.7	44.4	1.9	42.7
08/25/92	240	70318	4042	87.5	43.6	43.6	1.6	39.8
09/07/92	240	70331	4050	83.3	39.6	43.4	2.0	37.7
09/23/92	240	70347	4060	83.0	40.4	42.6	2.0	34.1
10/19/92	240	70373	4080	77.0	35.9	41.4	1.7	35.8
11/08/92	240	70393	4090	83.0	38.6	44.4	1.9	41.7
12/13/92	240	70428	4120	65.2	25.3	39.9	1.4	30.9
01/21/93	240	70467	4140	74.0	36.4	37.4	1.4	34.8
02/17/93	240	70494	4160	76.0	35.4	40.6	1.6	36.4
03/20/93	240	70525	4180	73.7	32.6	41.1	1.6	39.6
04/22/93	240	70558	4200	82.3	38.1	44.1	1.8	39.5
05/20/93	240	70586	4220	85.0	40.4	44.4	2.0	38.0
06/16/93	240	70613	4240	91.3	46.2	45.2	2.1	40.4
07/14/93	240	70641	4260	84.0	40.6	43.4	2.1	37.7
08/17/93	240	70675	4280	85.8	39.9	45.9	2.2	36.1
08/30/93	240	70688	4290	77.5	33.6	43.9	1.7	35.9
09/13/93	240	70702	4300	78.0	33.4	44.6	2.0	35.6
10/11/93	240	70730	4320	75.3	29.6	45.7	1.8	34.1
11/07/93	240	70757	4330	80.0	31.9	48.2	2.0	35.2
12/17/93	240	70797	4360	51.4	23.8	27.6	0.9	30.3
01/28/94	240	70839	4380	54.4	24.8	29.8	0.9	28.8
02/23/94	240	70865	4400	69.7	32.4	37.4	1.3	36.8
03/26/94	240	70896	4420	65.5	30.4	35.1	1.5	33.4
04/22/94	240	70923	4440	63.7	28.3	35.6	1.4	34.4
05/26/94	240	70957	4460	56.4	26.6	29.6	0.9	34.6
06/18/94	240	70980	4480	65.0	31.9	33.1	1.7	34.5
07/06/94	240	70998	4490	71.5	37.6	33.9	1.6	38.0
08/21/94	240	71044	4520	62.7	25.8	36.9	1.3	33.5
09/05/94	240	71059	4530	68.2	33.1	35.4	1.2	37.6
10/03/94	240	71087	4550	61.2	24.3	37.1	1.1	26.2
10/30/94	240	71114	4570	55.7	20.1	35.6	1.4	28.6
11/15/94	240	71130	4580	31.1	11.3	19.8	0.4	17.6
01/12/95	240	71188	4610	35.1	12.3	22.8	0.4	18.1
02/11/95	240	71218	4630	22.8	0.8	21.8	0.1	14.7
03/20/95	240	71255	4660	71.7	34.1	37.6	1.3	36.1
04/13/95	240	71279	4670	53.7	19.3	34.4	1.1	28.3
05/11/95	240	71307	4690	59.7	20.3	39.4	1.9	28.5
06/07/95	240	71334	4710	66.2	25.1	40.9	1.8	30.9
07/23/95	240	71380	4740	76.5	33.1	43.4	2.1	34.1
08/18/95	240	71406	4760	60.5	19.1	41.4	1.4	28.4
09/18/95	240	71437	4780	63.0	15.8	47.2	1.6	25.8

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
10/16/80	252	65987	1200	198.2	129.7	68.7	3.6	67.4
01/15/81	252	66078	1250	188.4	116.9	71.5	3.2	60.5
04/09/81	252	66162	1310	204.7	135.0	69.7	3.2	70.1
07/15/81	252	66259	1370	207.9	137.2	70.5	3.2	74.9
01/08/82	252	66436	1490	210.2	138.0	72.2	3.1	74.5
05/05/82	252	66553	1570	210.5	138.2	72.2	3.2	74.4
07/16/82	252	66625	1610	215.0	145.2	69.7	3.2	69.3
01/09/83	252	66802	1730	202.7	130.7	72.0	3.3	68.8
04/20/83	252	66903	1800	208.9	132.9	75.8	3.4	66.2
07/12/83	252	66986	1850	204.2	129.7	74.5	3.5	63.2
10/18/83	252	67084	1920	197.4	121.9	75.3	3.5	59.3
01/08/84	252	67166	1970	207.9	130.4	77.5	3.8	67.1
07/09/84	252	67349	2090	197.4	121.7	75.8	3.7	63.5
10/20/84	252	67452	2160	217.0	142.5	74.8	3.7	66.9
06/01/85	252	67676	2300	198.2	128.9	69.2	3.5	70.3
06/28/85	252	67703	2320	201.9	130.9	71.0	3.7	69.4
07/31/85	252	67736	2340	198.7	124.4	74.0	3.8	60.1
09/28/85	252	67795	2380	201.2	125.9	75.0	4.1	61.6
11/04/85	252	67832	2400	211.0	133.7	77.5	4.1	70.7
11/29/85	252	67857	2430	211.0	135.5	75.5	4.1	67.1
12/27/85	252	67885	2440	216.5	138.5	78.0	4.0	69.4
02/18/86	252	67938	2480	196.2	121.9	74.2	4.1	63.7
03/07/86	252	67955	2490	201.4	126.9	74.8	4.1	63.9
06/03/86	252	68043	2550	195.2	120.9	74.2	4.0	57.4
06/30/86	252	68070	2560	196.2	122.2	74.0	3.9	57.2
07/09/86	252	68079	2570	196.7	118.9	77.8	4.0	57.5
08/11/86	252	68112	2590	193.1	115.9	77.3	4.0	54.9
08/31/86	252	68132	2610	193.4	117.4	76.0	4.0	56.8
09/27/86	252	68159	2620	199.2	122.7	76.3	4.0	56.4
10/01/86	252	68163	2630	201.4	124.2	77.0	4.0	61.6
12/06/86	252	68229	2670	196.4	118.6	77.8	4.0	62.7
01/06/87	252	68260	2690	177.8	99.8	77.8	3.9	54.4
02/10/87	252	68295	2710	193.9	115.9	77.8	4.1	61.2
03/07/87	252	68320	2730	192.6	114.6	78.0	4.0	61.3
04/02/87	252	68346	2740	195.9	118.4	77.5	4.0	59.7
04/30/87	252	68374	2760	200.4	124.7	75.8	4.0	59.7
05/08/87	252	68382	2770	200.7	124.4	76.3	4.0	66.6
05/28/87	252	68402	2780	195.4	117.9	77.3	4.1	59.1
06/26/87	252	68431	2800	200.9	123.9	77.0	4.0	62.0
08/10/87	252	68476	2830	192.4	114.9	77.5	4.0	58.0
08/24/87	252	68490	2840	204.2	126.9	77.3	4.0	62.5
09/23/87	252	68520	2860	208.2	130.9	77.5	4.0	62.1
04/27/88	252	68737	3000	171.6	94.8	76.8	4.1	51.4
04/27/88	252	68737	3001	171.6	94.8	76.8	4.1	51.4
07/17/88	252	68818	3060	184.1	106.9	77.3	4.1	61.3
08/24/88	252	68856	3080	190.9	119.4	71.5	4.3	66.5
09/16/88	252	68879	3100	196.9	119.1	77.8	4.4	67.4
01/18/89	252	69003	3420	190.4	114.6	75.8	4.4	66.4
07/10/89	252	69176	3290	183.1	106.6	76.3	4.6	59.9
01/03/90	252	69353	3410	157.8	81.0	76.5	4.7	52.4
04/27/90	252	69467	3480	165.1	88.3	76.8	4.8	52.4
07/01/90	252	69532	3530	154.3	76.0	78.5	4.8	48.0
08/15/90	252	69577	3560	162.3	89.3	72.7	4.6	53.3
09/13/90	252	69606	3580	161.5	85.8	75.8	4.6	49.7
10/17/90	252	69640	3600	185.4	111.4	74.0	4.7	59.7
11/07/90	252	69661	3610	150.3	76.3	74.0	4.8	49.4
01/15/91	252	69730	3650	173.3	96.6	76.5	4.8	58.0
01/19/91	252	69734	3660	156.3	83.0	73.2	4.7	51.2
02/15/91	252	69761	3680	168.6	95.8	72.7	4.6	58.3
03/24/91	252	69798	3700	161.0	87.5	73.7	4.4	55.1
04/27/91	252	69832	3720	157.3	85.5	71.7	4.7	53.2
04/29/91	252	69834	3720	216.5	140.5	76.3	4.8	84.3
05/25/91	252	69860	3740	153.5	85.0	68.5	4.0	51.8
06/29/91	252	69895	3760	159.5	85.3	74.2	4.5	54.1
07/27/91	252	69923	3780	155.8	83.3	72.5	4.8	47.3
08/22/91	252	69949	3800	154.5	83.3	71.5	4.7	52.8
09/13/91	252	69971	3820	159.5	86.3	73.2	4.9	50.6

Date	Profile	Days From 1800	Survey	V_T (m3/m)	V_S (m3/m)	V_L (m3/m)	E_B (m)	P (m)
09/19/91	252	69977	3820	169.6	97.3	72.2	4.8	56.6
10/15/91	252	70003	3840	179.9	106.9	73.0	4.8	64.5
10/28/91	252	70016	3851	148.0	77.5	70.5	4.5	56.1
11/11/91	252	70030	3852	156.3	83.0	73.0	4.7	60.1
11/17/91	252	70036	3860	164.6	90.8	73.7	4.9	58.3
11/18/91	252	70037	3860	156.8	83.0	73.5	4.8	55.4
12/15/91	252	70064	3880	150.5	79.8	70.7	4.7	49.3
01/17/92	252	70097	3900	152.3	81.5	70.7	4.7	57.1
02/03/92	252	70114	3910	152.0	77.5	74.2	5.0	50.4
02/27/92	252	70138	3920	154.3	84.0	70.2	4.4	56.1
03/27/92	252	70167	3940	158.3	87.5	70.7	4.8	53.9
04/15/92	252	70186	3960	148.7	77.0	71.7	4.8	48.2
05/14/92	252	70215	3970	158.3	88.8	69.5	4.4	59.8
05/30/92	252	70231	3990	149.0	77.0	72.0	4.9	48.8
06/10/92	252	70242	3990	161.5	92.3	69.0	4.6	55.9
06/30/92	252	70262	4010	164.0	92.3	71.7	4.9	56.5
07/28/92	252	70290	4020	175.1	107.6	67.2	4.4	60.0
08/25/92	252	70318	4042	171.3	103.3	68.2	4.4	57.0
09/07/92	252	70331	4050	131.2	61.7	69.5	4.6	42.2
09/23/92	252	70347	4060	151.0	81.5	69.5	4.4	58.4
10/19/92	252	70373	4080	155.5	85.8	69.7	4.5	55.7
11/08/92	252	70393	4090	152.8	82.8	70.0	4.2	54.5
12/13/92	252	70428	4120	141.2	71.2	70.0	4.0	49.3
01/21/93	252	70467	4140	150.3	83.3	67.0	4.5	56.3
02/17/93	252	70494	4160	148.5	78.0	70.5	3.7	50.7
03/20/93	252	70525	4180	148.2	80.0	68.2	3.8	55.9
04/22/93	252	70558	4200	155.8	88.8	67.0	4.5	59.0
05/20/93	252	70586	4220	154.5	87.3	67.2	4.1	54.1
06/16/93	252	70613	4240	157.0	89.8	67.2	4.0	55.7
07/14/93	252	70641	4260	161.0	93.1	68.0	4.0	55.4
07/17/93	252	70644	4260	154.3	85.8	68.5	3.9	53.8
08/17/93	252	70675	4280	155.8	88.8	67.0	4.2	56.7
08/30/93	252	70688	4290	170.8	108.9	62.0	4.1	61.1
09/13/93	252	70702	4300	158.5	90.1	68.5	3.7	55.2
10/11/93	252	70730	4320	143.5	76.5	67.0	3.9	50.4
11/07/93	252	70757	4330	144.5	75.3	69.2	3.8	49.4
12/17/93	252	70797	4360	132.2	64.7	67.7	3.4	47.9
01/28/94	252	70839	4380	141.2	72.0	69.2	3.9	49.3
02/23/94	252	70865	4400	151.5	84.5	67.0	4.7	56.6
03/26/94	252	70896	4420	140.0	71.0	69.0	3.6	52.5
04/22/94	252	70923	4440	145.0	75.8	69.2	4.3	51.3
05/26/94	252	70957	4460	132.7	64.0	68.7	3.6	52.2
06/18/94	252	70980	4480	136.0	68.2	67.7	3.3	48.5
07/06/94	252	70998	4490	140.2	71.7	68.7	4.0	48.4
08/21/94	252	71044	4520	138.7	70.5	68.2	3.8	49.1
09/05/94	252	71059	4530	139.7	70.0	69.7	3.7	53.3
10/03/94	252	71087	4550	142.0	73.7	68.2	3.7	51.1
10/30/94	252	71114	4570	137.7	69.0	68.7	3.7	45.3
11/15/94	252	71130	4580	102.3	38.6	63.7	2.0	36.2
01/12/95	252	71188	4610	128.9	58.9	70.0	3.7	45.3
02/11/95	252	71218	4630	113.4	47.2	66.2	2.5	44.8
03/20/95	252	71255	4660	125.2	58.9	66.5	2.9	46.9
04/13/95	252	71279	4670	118.6	52.4	66.2	2.9	42.8
05/11/95	252	71307	4690	129.2	61.5	67.7	2.7	44.5
06/07/95	252	71334	4710	127.2	59.7	67.5	2.8	45.8
07/23/95	252	71380	4740	150.3	80.3	70.0	3.3	51.2
08/18/95	252	71406	4760	132.4	64.7	67.7	3.0	46.9
09/18/95	252	71437	4780	128.9	62.2	66.7	3.0	45.1

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13. ABSTRACT *(Maximum 200 words)*

The results summarized herein are based on subaerial beach profiles taken on the Atlantic Ocean at Sandbridge, VA, which has experienced an average historic erosion rate of about 2 m/year for more than 120 years before seawall construction began in 1980. The purpose of this ongoing study is to determine, from statistically defendable data, whether or not the 15 different walled sections increase the existing erosional trend at adjacent, nonwalled beaches. Fifteen years of survey data are employed with eight to nine years of variable data taken before wall construction peaked in 1989. The main focus of these results is on 5 full wave years of monthly and poststorm survey data taken at 28 locations (16 walled locations (62 percent), totalling 4,470 m and 12 nonwalled locations (38 percent), totalling 2,950 m) since October 1990. Three time scales (historic, seasonal, storms) and three analysis methods were used to address three questions concerning the effects of seawalls on adjacent beaches.

It has been determined that volume erosion rates are not higher in front of seawalls. However, seasonal variability of sand volume in front of walls is greater than at nonwalled locations. Walled beaches were found to recover about the same time as nonwalled beaches for both seasonal transitions (winter to summer) and

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following erosional storm events. At a few nonwalled locations, the long-term, average sand volume landward of adjacent walls was found to be eroding at a faster rate, but when considering the study area as a whole, the evidence was considered inconclusive through September 1995.

This report also discusses methods to estimate annual volumes for sand "mitigation" to replace that being held out of the littoral system by the seawalls, which are built on private property with private funds to protect septic tanks, concrete driveways, and other property, not to protect the beach.

The evidence so far clearly demonstrates that the "seawalls versus beaches" controversy is not a clear-cut issue, especially where "natural" erosion existed before wall construction, as is the usual case. Additional seasonal volume fluctuation in front of seawalls is of concern for design. Quantification of additional erosional impacts for property adjacent to seawalls will aid in the development of mitigation legislation so that the full range of shore protection alternatives (hard, soft, sand traps, and combinations) can coexist in the coastal zone.